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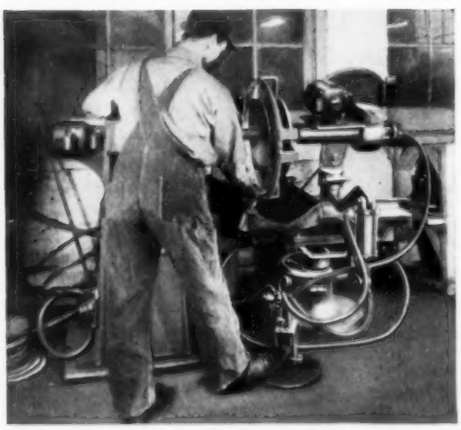

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CONTINENTAL

METAL INDUSTRY
FABRICATION · ASSEMBLING · PLATING · FINISHING
VOL. 37, NO. 8 AUGUST, 1939

Silver Prices Reduced

Out of the confusion of Washington politics, silver has recently emerged with its price basis changed. For some time the Treasury has been buying newly mined silver in this country at a price of 64.64c per ounce. This price, by Act of Congress, has now been raised to 71.1c.

The Treasury also is still empowered to continue its purchase of foreign silver and each day sets the price at which it will buy. This price usually follows the trend of the London market, where the tendency of late has been down. The prices for the settlement of all commercial transactions in this country as announced by Handy and Harman after continuing over a long period at 42¾c per ounce, have gone lower in keeping with world market conditions, and on July 6th reached 36½c—a drop of 6¼c in less than two weeks.

Such a change of, roughly, 15% naturally affects the arts and industries where silver is used in large volume. The industrial uses of silver, which have expanded rapidly in recent years, especially in the making of brazing alloys for joining ferrous and non-ferrous metals, should benefit particularly from the lower commercial prices.

Other silver products used industrially, such as anodes for plating, silver for electrical contacts, fine silver and silver clad metals used in making equipment where corrosion is a problem, and powdered metals containing silver will be priced in accordance with the changed silver market.

Barrel Nickel Plating

One of the remaining weaknesses in the maintenance of high quality plating is barrel nickel plating. High quality plating is generally found on automobile parts which are rack plated, but inspection of screws and small parts which have been barrel plated, will often reveal severe rusting on cars only a few weeks old. High grade appliances such as toasters or electric irons are made with the major parts having beautiful, corrosion-resistant, heavy nickel plates but at the same time, the handle brackets, screws, hinges and other small parts may be inadequately protected with thin nickel coatings applied in barrels.

Analyses were recently made of barrel nickel plated parts on electric irons of six leading manufacturers. The heaviest nickel coating found was 0.0002″ and the lightest 0.00001″ with an average thickness of approximately 0.00009″. The thicknesses of the larger rack plated parts were adequate ranging from 0.0005″ to 0.0009″.

If the larger parts need a nickel thickness of 0.0009″, then surely adjacent smaller parts need the same amount. It is incongruous to have one part with 0.0009″ and others with 0.00009″ of nickel, particularly on supposedly high grade merchandise.

The general lack of quality of barrel nickel plated parts is not due to deficient equipment, but rather due to the failure to realize the limitations of barrel plating equipment.

The average current density obtainable in closed horizontal barrels is about 2 amperes per sq. ft. which will deposit approximately 0.0001″ per hour. A current density of 19 amperes per sq. ft. which is easily obtained in conveyor plating will deposit 0.001″ an hour. The cathode efficiency in barrel plating is not particularly low, but it is the limiting low current densities which result in such slow rates of deposition.

Most frequently, the engineer, production man, or designer will specify—"one hour barrel nickel plate" ostensibly with the thought that the coating is as good as one hour of rack plating at much higher current densities.

Apparently it is not yet generally known that the number of ampere-hours of current determines the quantity of plate and not the number of hours!

Due to the long time necessary to secure high

quality barrel nickel plating (5-15 hours), the plating time may be shortened, in times of heavy production, to "turn out the work" even though the deficiencies of short time plating are known.

Some recommendations for barrel plating are:

1. Check barrel plated parts for thickness and porosity as regularly as rack plated parts.

2. Do not load the barrel so full that the work cannot rotate.

3. Small parts have proportionately greater area to weight ratios than larger parts and hence proportionately smaller loads should be used.

4. Do not expect to do the cleaning in the plating barrel. Poorly cleaned work may cause peeling of the plate, poor throwing power or coverage and delayed plating.

5. Make certain electrical connections and anode area are adequate.

6. Check the solution regularly because of high drag-out losses and of rapid pH changes due to high drag-in of acid or alkali from the last dip.

7. Have several barrels with various size openings so as to be able to use the largest size opening without clogging by the work. Large openings not only permit higher current densities to be obtained, but they insure proper replenishing of the plating solution inside the barrel.

Barrel plating of zinc and cadmium has been, on the whole, satisfactory because of the nature of the protection afforded by even thin coatings of these metals. A thickness of 0.0002" of zinc or cadmium may last one or more years outdoors and many more years indoors, whereas 0.0002" of nickel may fail in a few days outdoors and in a few weeks indoors if the humidity is high.

High quality barrel plating can only result from proper operation by the plater and from a more thorough understanding by the designer, engineer, production man and specification writer.

Economical Use of Water

The obtaining of an adequate supply of water suitable for plating purposes is frequently a difficult problem. The difficulties attendant with contaminated water have already been described in the April issue. We would like to briefly discuss here the proper utilization of rinse water.

The three ways of rinsing are: (1) immersion rinsing, (2) immersion rinsing followed by a spray rinse used to replenish the rinse tank, and (3) spray rinsing. Method (1), immersion rinsing, is most generally used and is least efficient and the most expensive. Large volumes of water must be used to produce changes in the water sufficient to prevent contamination: chromium plating solution films, emulsifiable solvent cleaners and alkaline cleaners with soaps or wetting agents are removed with difficulty; separate rinsing tanks must be used for different plating solutions to prevent contamination.

The use of spray rinsing with immersion rinsing is much more effective than simple immersion rinsing but the water consumption is still high.

Spray rinsing using a high pressure, fine atomization of the water appears to be most economical and effective although certain parts which contain joints or folds of metal are more effectively rinsed by immersion rinsing because of the need for the water to penetrate the crevices. The use of spray rinsing has been retarded by several factors; namely, poor design, clogging of the nozzles with rust or foreign matter in the water, and poor control of the rinsing.

Recent work has shown that effective, economical rinsing can be accomplished with less than normal water heads and with easy effective control for intermittent use. Some of the advantages made possible by the newer spray rinse techniques are:

(1) Large economies in water costs.

(2) Reduction of sewer loads.

(3) Reduction in number of rinse tanks because one spray rinse tank can be used for rinsing many different solutions.

(4) Reduction in number of rinse tanks because of more effective rinsing.

(5) Reduction in rinsing time.

(6) Prevents contaminating of plating solutions by preventing drag-in of acid or alkali.

(7) Reduces spotting or staining of finished work due to ineffective rinsing.

(8) Permits the use of more effective cleaners by allowing the use of wetting agents or detergents usually difficult to rinse.

Spray rinsing is, in most cases, the logical, scientific method of rinsing and the present developments of suitable nozzles, filter screens and water controls should result in widespread adoption of spray rinsing apparatus.

The Value of the Microscope

To the Electroplater—Part III

By Dr. B. Egeberg and N. E. Promisel

International Silver Co.,
Meriden, Conn.

This is the concluding part of the authors' beautifully illustrated article on the use of the microscope. Etchants for developing the crystal structures of metals and alloys are described. Photomicrographs illustrating additional uses of the microscope are given.—Ed.

Before etching, the freshly polished sample, still wet, should be rinsed under the water faucet to remove polishing grit and if water breaks on the surface, indicating a grease film, it should be washed in alcohol, rinsed again and etched immediately, usually by immersion in the etchant. In some cases, it is beneficial to brush the specimen while it is immersed in order to obtain a more uniform etch and to remove reaction products of a more or less insoluble nature. Due to the complications arising from several metals and electroplates in contact with one another and also for other reasons, sometimes unknown, better results are frequently had by not immersing the sample, but by swabbing it with the solution using either the finger tip or a hairbrush.

After the specimen is properly etched, it is rinsed in running hot water and dried in an airblast.

Further Uses for the Microscope

An indication may even be obtained sometimes concerning the type of plating solution used. Thus the copper deposit in Fig. 14 (Part II) is from the usual sulfuric acid solution containing no addition agent, in Fig. 15 (Part II) from the same solution after adding phenol sulfonic acid, and in Fig. 19 from a cyanide solution. Figs. 20 and 21 show silver deposits from "unbrightened" and "brightened" solutions, respectively.

The composition of the basis metal and whether it is in the cast or rolled condition are other types of information afforded by microscope study, observations of color and crystal structure being important in these cases. Fig. 22 shows the structure of heat-treated electrolytic iron, Fig. 23, low-carbon steel, Fig. 24, coring in non-ferrous metal—typical of cupronickel and nickel-silver alloys, Fig. 25, Britannia metal.

The microscope renders invaluable service to the electroplater not only when he is facing the problem of testing an unknown article, but also in the control and study of his own product. Though somewhat slow and laborious, and, by necessity, destructive to the article itself, there is no other single test which is capable of furnishing such a wealth of information. Electroplaters familiar with the microscope will have no difficulty in making additions to the above list of useful purposes which the microscope can serve. Some may use it for studying defective electroplates or the relation, if any, between crystal orientation in the basis metal and in the plate. Fig. 26 shows silver plated on nickel-silver and thereafter annealed. In Fig. 27 the continuity in a deposit of electrolytic iron is interrupted by occasional removal of the article from the solution for the purpose of inspecting the plate and Fig. 28 shows the same deposit after annealing. Others may use it for determining the relative hardness of successive layers of electroplates as by making a needle scratch across the polished cross-section and by judging the hardness by the width of the scratch (as illustrated in Fig. 29), or they may use the microscope for a study of the effect of polishing upon the electroplate (Fig. 30) or for studying the thickness of electrodeposited copper required to prevent case carburizing of steel (Fig. 11. Part I).

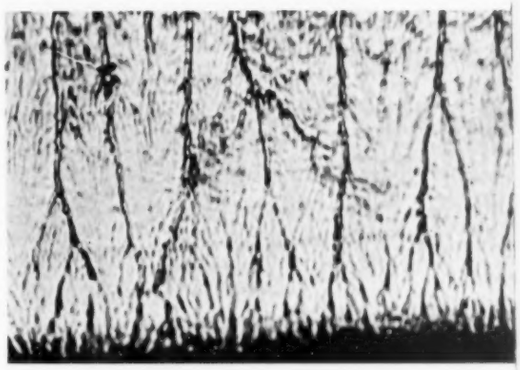


Figure XIX. Microscopic structure of copper electroplated from cyanide solution. 1000*X. (After W. R. Meyer).*

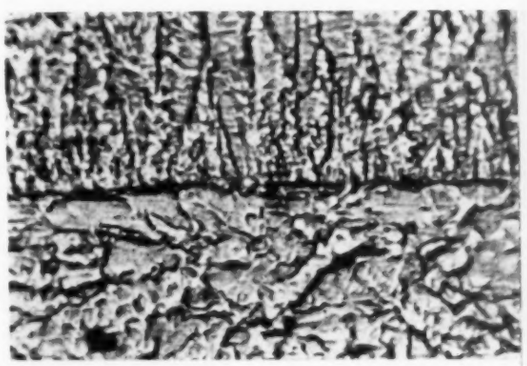


Figure XX. Columnar silver plate from cyanide bath. Top half silver plate. 1000*X. (After Wood).*

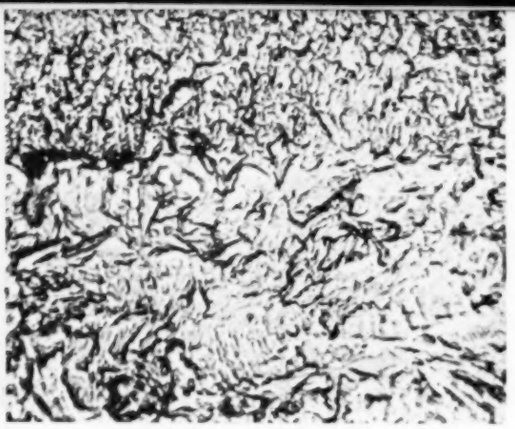


Figure XXI. Fine grained silver electroplated from cyanide bath containing carbon disulfide. Upper half silver plate, lower half basis metal. 100X. (After Wood).

Figure XXII. Electroplated iron annealed at 1200° F. for 15 minutes. 200X.

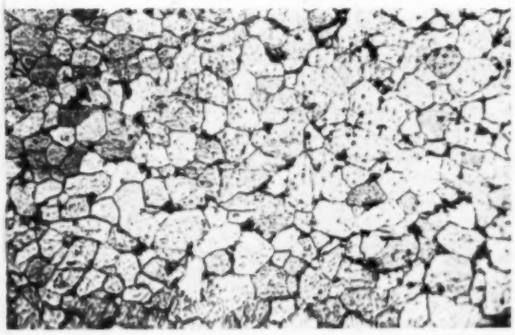


Figure XXIII. Hot rolled and annealed low carbon steel. 100X.

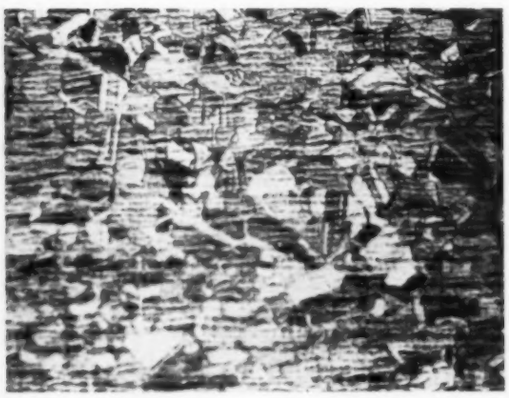


Figure XXIV. Coring lines (segregation) typical of copper-nickel alloys in direction of the rolling. Photo taken out of focus to emphasize the coring lines. 100X.

Table of Etching Solutions for Electroplates and Basis Metals

Electroplates must normally be examined at higher magnification than the basis metal. An attempt has, therefore, been made to select such reagents which serve both high and low power magnification.

Metal	*Etching Solution*
Iron and Steel	(a) 10% aqueous solution of ammonium persulphate freshly prepared.
	(b) Benedicks' solution: 5% solution of metanitrobenzol sulphonic acid in ethyl alcohol.
	(c) Kourbatoff's solution: 4% nitric acid in amyl alcohol.
Copper, Brass and Bronze	(a) 10% aqueous solution of ammonium persulphate freshly prepared. Sometimes better results are obtained by adding a few drops of ammonia.
	(b) Copper ammonium chloride ..... 5 gm. Water ..... 120 c.c. Ammonia is added until the precipitate first formed is redissolved.
	(c) One part strong ammonia, one part hydrogen peroxide (3%). Sometimes better results are obtained by increasing the peroxide content several times.
	(d) Anodic treatment in 1% H_2SO_4.
Nickel	(a) Merica's reagent: Nitric acid ..... 20-40 c.c. Acetic acid ..... 30-40 " Acetone ..... 30-40 "
	(b) Potassium nitrate, 25% solution in water, specimen anodic.
Nickel Alloys: Copper: nickel, Monel, Nickel silver.	These can all be etched with the solutions given for pure nickel. When the nickel content is low, many of the solutions given for copper and copper alloys are serviceable. For example, ammonium persulphate is a preferred etching reagent for nickel silver.
Aluminum and its Alloys	(a) Sodium hydroxide, 10% solution in water. A dark deposit is obtained on the etched specimen which, after rinsing, is removed by immersing for a moment in strong nitric or chromic acid.
	(b) Warm the specimen in hot water and treat immediately with either of the following etchants: Nitric acid ..... 1 vol. Hydrofluoric acid ..... 2 " Glycerine ..... 3 " or Swab with hydrofluoric acid, 0.5% solution in water.
White metals: Tin, Lead,	(a) Hydrochloric acid, 1-5% solution in water or alcohol.
	(b) Nitric acid ..... 1 vol.

Antimony, Bismuth, and their alloys. Britannia metal.		Acetic acid	3 "
		Glycerine	15 "
		The structure of solders is often developed during the polishing operation.	
	(c)	5% aqueous ammonium persulfate blackens tin but not tin-iron alloy.	
Silver and its Alloys. Sterling		Solution "A"—Con. nitric acid	500 c.c.
		Water	500 "
		Potassium dichromate	20 g.
		Solution "B"—Chromic acid (CrO_3)	20 g.
		Sodium sulphate	1.5 g.
		Water	100 c.c.
		Mix 1 part "A" and 20 parts "B" plus 20 parts water shortly before use.	
Gold and its Alloys.		For 14 K gold and lower karats use dilute nitric acid.	
		For 18 K gold use aqua regia.	
Zinc and its Alloys	(a)	Nitric acid	94%
		Chromic acid	6 "
		A few drops of this stock solution are added to 100 c.c. of water immediately before use.	
	(b)	Chromic acid	50 g./l.
		Sodium sulphate	4 "
		Etch for about 5 seconds.	
Chrome		Chromic acid	450 g./l.
		Sulfuric acid	0.5 "
		Temperature	175°F.
		Specimen anodic.	
		Use lead cathode.	
		Current density	2.5 amps./sq. ft.
		Time	5-600 minutes

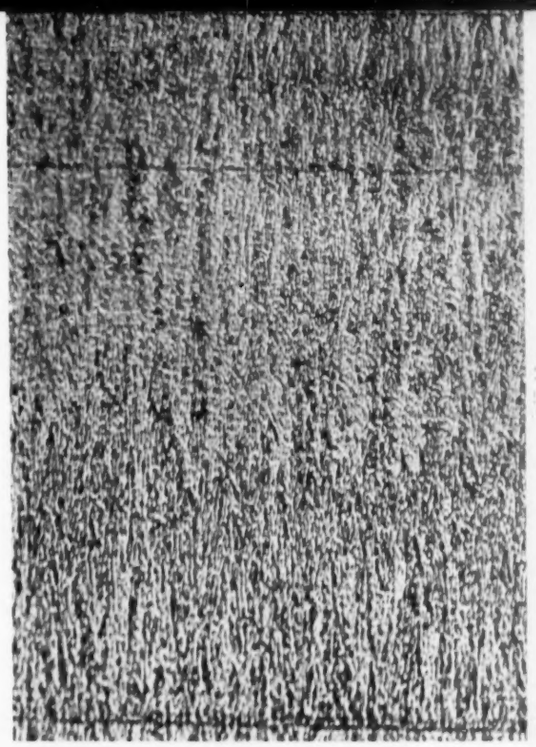


Figure XXVII. Electroplated iron showing parallel lines where deposition has been interrupted. 200X.

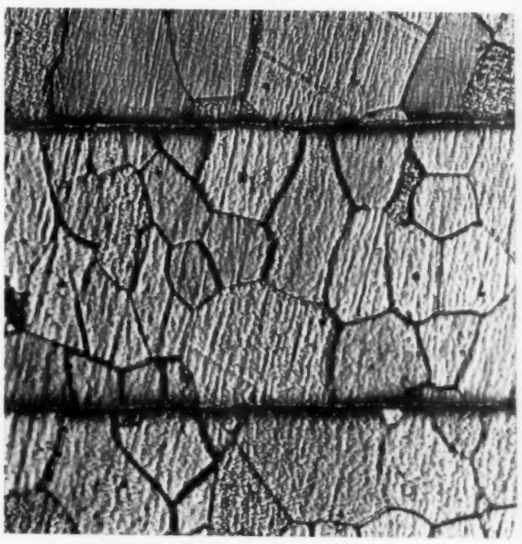


Figure XXVIII. Same as Fig. XXVII after annealing for 2 hrs. at 1500°F. Shows that the grain often crosses the lines of interrupted plating. 200X.

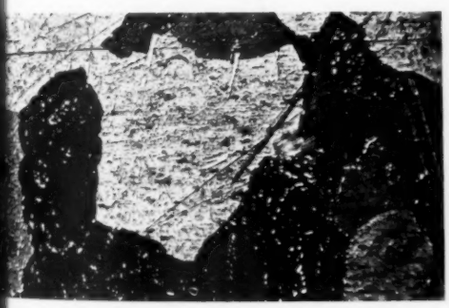


Figure XXV. Britannia metal after recrystallization by annealing at 400° F. 250X.

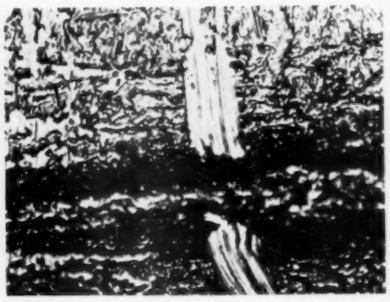


Figure XXIX. Hard inclusion in copper-nickel alloy, not scratched by needle. 1000X.

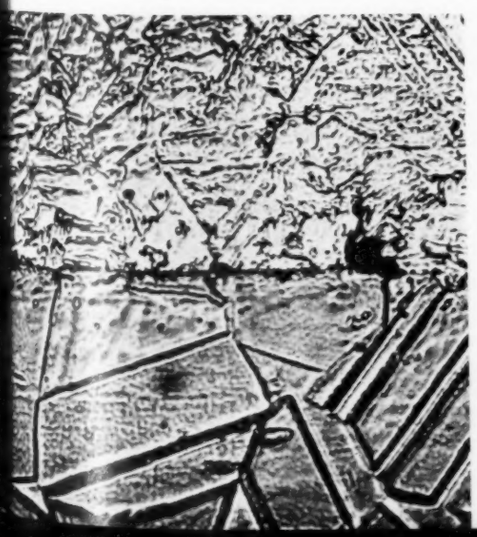
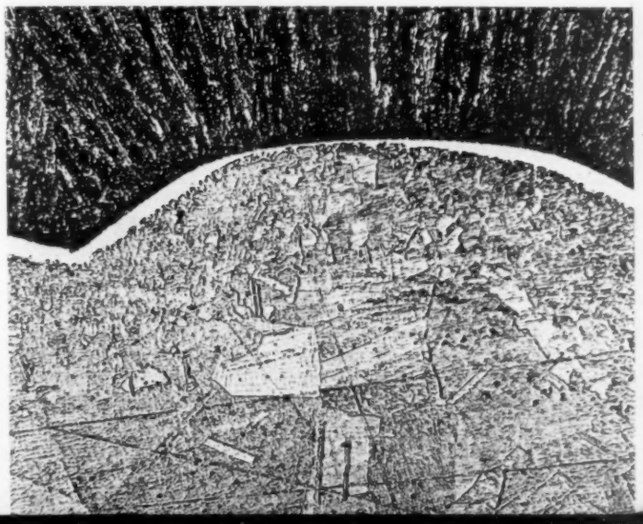


Figure XXVI. (Left). Annealed silver plate (top half) showing some orientation from basis metal. 1000X.

Figure XXX. (Right). Electroplate nearly removed by buffing on top of raised part. 350X.



Identification of

Light Metal Alloys

By Edmund R. Thews

Consulting Metallurgist

Mr. Thews, who is of international reputation, has written this article on identification of light metal alloys at our request. He is the author of "Metallurgy of White Metal Scrap and Residues" and has had years of experience on the problem which he discusses. The identification of white metal scrap by chemical spot tests is described together with an extensive discussion of the handling of scrap.—Ed.

Introduction

The methods of identification and sorting of scrap metals and alloys will always remain short tests of an optical or visual nature based on practical experience and observation. This does not mean that this work is cut out chiefly for old gnarled yard hands of 40 or more years of "practical" scrap yard experience as still appears to be the generally accepted conception in many scrap melting and alloying plants. It is true that the identification of some groups of metals such as the various copper alloys (bronze, gun-metal, brasses, white-silver alloys, etc.) actually represent typical shop methods including the appearance of surface, fracture and fusion tests, degrees of brittleness and softness, grinding, filing and impression tests, etc., but even in these cases the task is entirely too serious to be handled by a skilled hand without the necessary technical and semi-scientific knowledge required for work of this type and involving technical and financial obligations of this scope. It is frequently overlooked by the general scrap treating smelters that the number of copper alloys employed, say, 20 years ago has been doubled five times over. Indeed, comparison of any modern list of contemporary proprietary alloys with the meagre tables published before 1910 yields much greater differences still. And the proprietary alloys form only a small percentage of the alloys actually produced in any foundry and finding their way back into the scrap pile sooner or later.

Handling of Scrap Metal

There is no "practician" to-day who could possibly tell all these alloys apart without resorting largely to chemical methods of the "rapid" type, such as spot tests, etc., followed subsequently by chemical analysis. Nevertheless, it is still possible, of course, to identify and sort mixed scrap into definite general groups such as, for instance, brasses rich or poor in zinc, or containing tin, or manganese, or a number of special constituents identifiable by simple shop tests. Large units weighing 100 lbs. and more may justify a special analysis, but mixed small scrap is melted together in the groups fixed by the sorter; the fused metal is then purified and analyzed before casting and the mixture corrected on basis of this analysis to suit requirements. This applies particularly to scrap material to be added directly to final alloys. It need hardly be mentioned here that the remelted scrap should not be used directly in the production of technical alloys but exclusively for the production of ingots of suitable composition which are then added to virgin metal mixtures in percentages of 20 to 30 percent. It has been found by experience that if the scrap is melted together, the composition determined, and suitable quantities of virgin metal added to this melt to obtain marketable alloys, the results obtained never reach the quality exhibited by alloys to which the secondary material has been added in form of remelted ingots.

The never ending discussions in American and European journals as to the advisability of adding remelted secondary metals to the virgin metal in the production of high grade technical alloys are largely due, in the author's opinion, to the application of the term "secondary." Scrap itself is practically poison to any virgin metal, no matter from where it has been derived. Foundry scrap obtained in one's own foundry, with compositions well known and impurities at a minimum is *rough scrap* and many of the difficulties encountered in smelters and foundries are due chiefly to the overlooking of this fact. If scrap, even of unknown origin is efficiently sorted, melted, purified, analyzed, alloyed and cast into ingots, these ingots are high grade material and can be added to any high grade alloy mixtures without compunction, although the amount added varies with conditions. Indeed, it is a matter of general practical

experience that the quality of alloys frequently is improved considerably by the judicial addition of secondary ingots. In many instances, it is advisable to remelt a virgin alloy for the purpose of improving its technical properties. The alloy is first made, cast into slabs or ingots, broken to small pieces and these pieces melted and cast over again (into the proper moulds). In all cases of this type, the addition of suitably composed and pure secondary ingots forms an advantage, not a disadvantage, with regard to the technical and physical properties of the castings produced. The homogeneity and uniformity as well as all mechanical properties are improved, a consequence probably of the greater degree of homogeneity and uniformity achieved.

It is obvious, of course, that the production of high grade alloys from secondary alloy mixtures involves more than the above considerations, but it was thought advisable in connection with the subject treated to call attention to this very important, but frequently ignored factor.

The general outline with regard to the identification of non-ferrous scrap holds good for practically all scrap melting activities but applies particularly to light metal scrap.

Identification of Scrap

The identification and sorting of aluminium and magnesium alloy scrap is much more difficult, particularly for the comparative beginner, than that of copper alloys or other non-ferrous materials. While on one hand, the light metal alloys have gradually developed into many more main and side groups than the copper alloys, the ranges of composition even within these individual groups are much wider and much less sharply pronounced. Besides, the appearance of many of the light metal alloys becomes practically identical after long usage. The appearance of the fracture also is no means of identification for a "practician" without knowledge of the metallurgical and metallographical features concerned, since apart from a much greater similarity of light metal alloy fractures (compared with those of the copper alloys) the changes introduced by mechanical, thermal and ageing treatments or by the natural ageing of many of these alloys generally are bound to induce so pronounced changes of the structure that the study of the fractures obtained from such a material yields no information to the uninitiated.

Another difficulty is that the shape, and the type of usage of the scrap parts evident from their shapes, cannot be made use of in estimating the probable composition of light metal scrap to as large a degree as in the identification and sorting of copper alloy scrap. It is comparatively easy for an experienced sorter to draw pretty close conclusions regarding the composition of, say, a large and bulky brass casting containing a small percentage of aluminium. He knows that this piece probably contains about 40% of zinc and a little aluminium to increase fluidity and decrease evolution of zinc oxide vapors, while a grinding test proves his guess as to the zinc content. The experienced sorter knows the approximate composition of brass or bronze pipes, bearing metals, etc. He knows the difference of surface appearance and fracture between gunmetal and straight bronzes, etc. but he cannot tell by similar experience the approximate composition of light metal castings, sheets, profiles, etc. because these parts and sections can be produced from dozens of aluminium and magnesium alloys impossible of superficial estimation by a sorter. Apart from the straight alloy scrap of this type there is also the intriguing system of aluminium plating of alloys for improved corrosion resistance by one or the other method (such as Alplat, etc.), there are anodic oxidation, aluminium painting and other surface changes rendering identification merely by appearance practically impossible.

Some important types of scrap which really should never be found among ordinary scrap on account of the questionable alloying qualities, but which frequently contaminate the public scrap piles include the *light metal pistons* which may be composed of all possible types of alloys including aluminium and magnesium alloys. Aluminium alloy pistons usually contain besides aluminium, copper, silicon, nickel and magnesium, and it will be shown below that the various piston alloy mixtures are so antagonistic to one another that even the pistons themselves must be kept apart unless their compositions are well known. Magnesium alloy pistons are more satisfactory in this respect; their compositions are rather uniform, consisting almost throughout of magnesium containing a few percent of zinc and silicon. If, therefore, piston shaped scrap has, on account of its lightness and drop test results been identified as magnesium alloy material, it may be collected into one pile and melted, or sold, as practically uniform magnesium alloy piston scrap, although it must not be permitted to be mixed with other magnesium alloy scrap.

Die cast light metal alloys of the aluminium base type do not differ much from aluminium piston alloys with regard to their alloying range. A very large percentage of this material contains besides aluminium, copper, silicon and magnesium, averaging about 6 to 8 percent of copper and 1.5 to 2 percent of silicon, but many other compositions have been found which, like the piston alloys, frequently tend to poison the other average scrap.

Chemical Spot Tests

It is thus evident that sorting of light metal scrap can be effected with reliable results only by modes of identification based on chemical reactions of so simple and obvious character that every intelligent and trained sorter can handle them. The most satisfactory methods of this type are the spot tests which if applied correctly and organized so as to become reliable in the hands of a non-chemist doubtlessly yield most reliable results under the operating conditions usually involved. This method is not difficult, although it may seem so at first. It will be shown that satisfactory results can actually be obtained with four solutions and it should be easy indeed to label the bottles so as to preclude any errors on the part of the sorters (blue, red, yellow and green labels) and by marking the instructions accordingly. Other smelters number the solutions 1, 2, 3 and 4 or give them some easily grasped common name, like "nitre" for nitric acid, "hydro" for hydrochloric, "caustic" for caustic soda and "sulphate" for cadmium sulphate solution. The author has found the color system and the numbering of the solutions

the most reliable, while the foremen knew these solutions by the short applications above mentioned. The solutions in question are composed as follows:

Solution No. 1: 30 *percent nitric acid*: Dissolve 30 parts of nitric acid in 70 parts of water.

Solution No. 2: 20 *percent caustic soda*: 20 parts by weight of caustic soda sticks (pure) in 80 parts of water. Filter the solution if cloudy.

Solution No. 3: 5 *percent hydrochloric acid*: Dissolve 5 parts of hydrochloric acid in 95 parts of water. Filter the solution if clouded by possible chloride contents of the water.

Solution No. 4: 5 *percent cadmium sulphate solution*: Dissolve 5 parts by weight of pure cadmium sulphate crystals in pure water.

Pure water and chemicals should be used in all instances in order to avoid cloudy testing solutions or doubtful reactions. It is easy, perhaps, for the trained chemist to note and identify erroneous indications, but the chemically untrained sorter must be supplied with solutions perfectly adapted to his own range of vision. It is also advisable, for the same reason, to provide the sorter with comparatively small testing bottles (about 100 cc capacity) fitted with drop stoppers, so that the danger of introducing impurities into the testing solutions is avoided.

The above solutions exhibit the following characteristic properties with regard to the various aluminium and magnesium alloys in question:

Solution No. 1 (30 percent nitric acid) differs from the other three solutions in that it yields positive reaction with magnesium alloys alone. If the cleaned or ground surface of a piece of scrap is provided with a drop of this solution, a magnesium-rich alloy is indicated if a white coloration is formed beneath this drop within about 5 minutes; the piece of scrap in question may thus represent Dow Metal or Electron or some other similarly composed alloy. This spot test does not yield results with any other types of light metal alloys. The white etching stain produced with a drop of Solution No. 1 usually forms a sure enough indication of magnesium-rich alloys which, however, can always be confirmed by the particularly light weight of these materials, while if still further confirmation is desired close attention should be paid to the liquid drop itself which will show a current of bubbles rising upward until the covered spot has been etched perfectly white.

It may be mentioned for reason of thoroughness that another test, although of negative character, proves the piece of scrap to be of the magnesium alloy group. It is well known that caustic alkali solutions attack aluminium alloys of practically any composition but do not touch magnesium or magnesium-rich alloys. If, therefore a drop of Solution 2 (20 percent caustic soda solution) is placed on another clean spot on the doubtful piece of scrap without causing etching beneath it within about 10 minutes, some metal of the Dow-metal or Electron type is indicated.

The Solution No. 2 (20 percent caustic soda solution) produces etching reactions with all aluminium alloys, i.e. with all alloys containing very considerable amounts of aluminum. The color of these etchings may be white (for pure aluminum and aluminium - magnesium alloys) grayish-brown and black, the different reactions being as follows:

White: Pure aluminum, aluminium-magnesium alloys and aluminum-magnesium manganese alloys. A distinction between these two chief types of metals can be made by adding a drop of Solution No. 4 (5 percent cadmium sulphate solution) on to another clean spot of the scrap. A gray coloration is induced after about 5 to 10 minutes on aluminium-magnesium alloys, while pure aluminium is not attacked at all. Attention is called to the fact that in the case of sheets, etc. the metal may be covered with pure aluminum by the Alplat process or some other method, and that if scrap of this type is found to be pure aluminium at the surface, the test should be repeated on the edge of a cutting.

Gray: Aluminium - silicon - copper alloy. The gray coloration is formed after 5 to 10 minutes. If the caustic soda solution is wiped off this spot and the latter covered with a drop of Solution No. 3 (5 percent hydrochloric acid solution), the gray color will remain. These two reactions form a clear mode of distinction between this and the next group of alloys.

Grayish-brown: Aluminium-silicon alloys, aluminum - silica - magnesium, and aluminum-magnesium-silicon alloys. The last named alloy is distinguished from the first two by the fact that on covering the grayish-brown spot with a drop of Solution No. 3 (after removing the Solution No. 2) the spot disappears within a few minutes.

Black: Aluminium - copper - nickel alloys, aluminum-copper-zinc alloys and straight aluminum-copper alloys. All alloys containing besides aluminium as base metal considerable quantities of copper, turn black if subjected to the action of Solution No. 2. If after removal of the alkali the spot is covered with a drop of Solution No. 3, elimination of the spot would indicate aluminium-copper-zinc alloys, while if the spots remain even after 8 or 10 minutes the respective copper-nickel or straight aluminium-copper alloys are indicated. A further means of distinguishing between these alloys is the reaction of Solution No. 4 (5 percent cadmium sulphate solution) which produces a gray spot on the aluminium-copper-zinc alloys ("German" alloys) but does not affect the straight aluminium copper alloys ("American" alloys) and the aluminium-copper-nickel alloys.

The Solution No. 3 is used in conjunction with No. 2 exclusively, i.e. it serves to form distinctions between alloys yielding the same spot reaction with Solution No. 2.

The Solution No. 4 (5 percent cadmium sulphate solution) is employed somewhat more independently, i.e. it is not dropped on to spots caused by Solution No. 2 but on freshly cleaned metallic surfaces directly. It produces gray spots on aluminium-copper-zinc alloys, aluminium-magnesium alloys, and aluminium - magnesium manganese alloys. The spots do not appear on aluminium-magnesium-silicon alloys, however, which serves as a means of distinguishing between the various aluminium-magnesium alloys. Solution No. 4 also distinguishes straight aluminum from the two groups of alloys yielding white spots under drops of Solution No. 2 the same as pure aluminum (aluminum - magnesium and aluminium - magnesium - manganese) since aluminum also remains unaffected by the Solution No. 4.

(Continued in Sept. issue)

Metal Spraying

By Carleton Cleveland

The development of metal spraying, the construction of spray guns and the utilization of sprayed metals are discussed in detail.—Ed.

Metals of various kinds have been used for thousands of years to create products for man's convenience and comfort, but the limit of their usefulness has not yet been plumbed. One of the more recent applications of metal is that in the form of a spray applied as a coating to objects of all kinds. This new metal-coating process has been given the name of metallizing.

Metallizing "is a process for spraying any metal of any melting point on any solid size or shape without preheating" is the definition given by J. W. Hishan in a lecture to the Dominion Association of Power Engineers

Figure I. One of the latest types of metallizing guns.

at the Mining Building, University of Toronto, November 7, 1935. It is a comparatively new process, but it is already extensively used in industry, and with modern equipment has become a highly developed method of spraying molten metal so that it will adhere to practically any solid base. The coating of metal thus put on any surface, if of sufficient thickness, can be ground, polished, machined, or given any other treatment which the pure metal will take.

The idea of spraying molten metal on objects is not exactly a new one. Inventors and metallurgists have been working on the process for about forty years. Early attempts to apply coatings of metal were rather crude; for instance, that early method of allowing a stream of

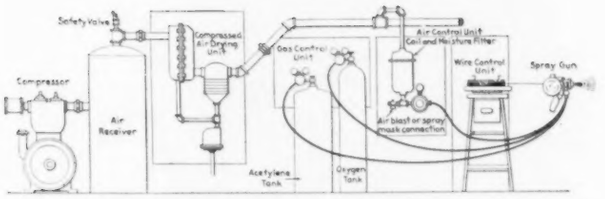


Figure II. Typical metallizing installation, showing various items required to insure proper and trouble-free operation.

molten metal to fall on a revolving disc, from which it was thrown tangentially onto the object to be coated; also the later method of supplying, by gravity from a suspended heated container and through a nozzle, a stream of molten metal which, meeting an air jet, was atomized and blown against the desired surface. The nozzle in this case was

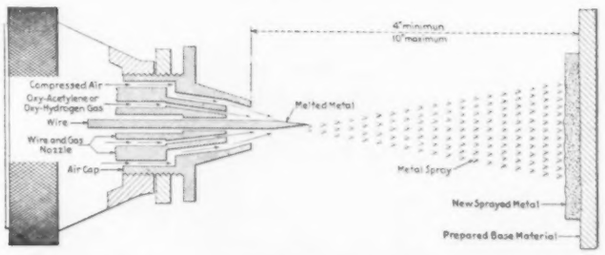


Figure III. Cross section drawing of nozzle of metal-spray gun, showing how wire is melted by oxy-acetylene or oxy-hydrogen flame; atomized by compressed air; and sprayed on prepared base material.

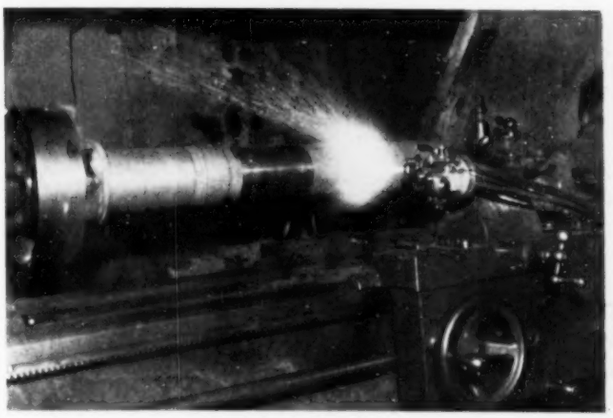


Figure IV. Building up a large lathe spindle with metal spray gun in fixed position.

Figure V. Restoring the worn bearings of a small air compressor crank shaft.

fixed, making it necessary to move the surface to be coated back and forth past the nozzle to receive an all-over coating. Another method was to use powdered or granulated metal blown from a container by compressed air through a hose to a gas flame heating chamber for melting and spraying. Excessive fumes and high spraying losses were objectionable features of this method.

Some twenty years ago, or shortly after the use of oxygen and acetylene was introduced in welding, the more modern method of spraying metal was developed. Dr. Schoop, a Swiss, is generally credited with originating the process, but others have done much towards its development. It is only recently, however, that it has been brought into its own as a coating process, because heretofore the cost of the equipment was prohibitive, and also because of a lack of technical knowledge concerning the details of the process, more or less unsatisfactory results had been obtained. These faults have, however, been overcome, and equipment has been perfected that can be purchased at more reasonable prices.

Dr. Schoop's invention consisted of feeding a metal wire mechanically through a flame, thereby melting the metal. An airblast, confined by a nozzle and surrounding the flame, atomized and propelled the continuous supply of atomized particles of molten metal forward onto the object. The molten metal, shot with a bullet-like speed against the object, adhered; and repeated blasts eventually built up a solid surface of metal. Early models of this type of metal spray gun were cumbersome and only moderately satisfactory. Even for a period of years that followed, the equipment available was unsteady in operation, required cleaning about every eight hours of operation if the softer metals were used, and needed such fine adjustments that no one but an expert operator could manage them.

During these early days, it must be admitted, metal spraying was not always successful, due largely to the fact that it was advanced as a "cure-all" without due consideration having been given to the structure of the various metals after they were sprayed—the general porosity of all metal coatings, the low tensile strength of sprayed metal, etc. Besides, so little was actually known as to technique and procedure in connection with this process which seemed so versatile. Wrong materials were chosen and the wrong technique was employed, which naturally ended in failure.

However, many improvements have been made from time to time, until today guns have been evolved which are considered practically perfect; in fact, fool-proof equipment is now built so that it is not necessary to have trained men to do this work. The latest type is ruggedly built, requires less cleaning, and the fine adjustments have been eliminated. Wire stoppages (which with the older type were a regular occurrence) are a thing of the past.

Many of the modern metal spray guns are constructed on the same underlying principles as that invented by Dr. Schoop. Metal wire is fed into the hot zone of a blowpipe flame by passing continuously through the central nozzle of a blowpipe fed with the combustible gas used and oxygen. In the ordinary course of events the metal would melt and drops of metal would fall from the nozzle. This, however, is prevented by surrounding the flame with a cone of compressed air which disintegrates the ever-forming globules and blows the metal forward as a fine mist.

Such spray guns have three supply lines: (1) a stream of air under pressure; (2) a stream of oxygen from a cylinder; (3) a stream of compressed gas, which may be producer gas of sufficient calorific intensity,—coal gas, hydrogen, acetylene, or the more recently used propane.

The gases are mixed in a small chamber behind the nozzle and pass down grooves concentrically out around the wire nozzle to the flame. The air supply leads to a valve which passes some of it to a self-contained high-speed turbine, and the remainder passes to the nozzle for the ejection of the metal particles. The turbine drives gears which reduce the speed considerably, and the gears in turn drive small rollers which pull in the wire.

A new type of metal spray gun, described in detail in the May, 1939, issue of METAL INDUSTRY, has recently been introduced. This has an attached crucible in which the metal is melted and held in reserve for a steady constant supply. From this container, it is siphoned into the air stream and discharged in a fine spray. The heat is supplied by a gasoline blow torch fully adjustable for heat requirements.

If a metal spray, using a modern type of gun, is moved continuously over a properly prepared metal surface, in a similar manner as in paint spraying, bands of metal will be formed that are homogeneous. Many layers may be added, in fact, as many as are desired; and any metal may be used that can be secured in wire form. The metals that can be commercially supplied for this purpose are lead, tin, zinc, babbitt, aluminum, bronze, brass, copper, iron, nickel, monel, steels (high and low carbon) and stainless steels.

One of the advantages of metallizing is that dissimilar metals can be applied one upon the other; for example, stainless steel or high carbon steel can be applied with equally satisfactory results to ordinary steel, cast iron, bronze, aluminum, or even the lower melting point metals such as lead or zinc. The method is also adaptable for spraying metals on glass, wood, cloth, and practically any other type of material.

To obtain satisfactory results, the base material must be clean, dry, and, in the case of metal, it must be rough so that the sprayed metal may bond firmly. Sprayed metal will not bond with a smooth metal surface, no matter how clean it may be. A roughened, pitted surface is needed to insure a dove-tailing of the globules or plastic metal. Grease or oxide on the surface will prevent a bond. If present, measures must be taken to remove these,—sometimes degreasing is necessary or a blow torch must be resorted to. Usually, however, sand or grit blasting or roughening with machine tools is the method used for preparing the surface to provide the minute "key fasts" or retaining points. Molten particles are impacted at speeds ranging from 10,000 ft. to 30,000 ft. per minute. The resultant bond is very intimate, but purely mechanical. No heat is applied directly to the base material either before, during, or after the metallizing process; consequently there is no warpage, no distortion, no heat strains and stresses, and no interference with the characteristics of the base material. It may seem strange, but the metal soon after it leaves the gun is sufficiently cooled so that a hand may be covered with any metal without experiencing any discomfort.

It can easily be seen that a metal spraying gun, to be practical, must come up to four requirements,—it must be portable and easily controlled; it must melt the metal; it must provide continuously a supply of metal to be sprayed; and there must be sufficient power to spray the molten metal.

Application fields for metal spraying may be divided into three classes,—coatings to resist corrosion, coatings to build up worn parts, fill blowholes, and resist abrasion; and coatings for decorative purposes. There are other individual uses which cannot be classified, as for instance, spraying copper on carbon for electrical contact, and many others too numerous to mention.

Coatings for the resistance to corrosion are usually thin coatings of the low melting point metals, and such protective coatings may be put on even after a product has been completely fabricated and set up in position,—thus all welds, rivets, and joints can be sealed in with the main structural material under a continuous protective sheathing. Furthermore, metal coatings can be built up more heavily in certain spots where greater wear occurs, and left at normal thickness on the rest of the article where the wear is not so great. Such situations are found in industries where certain pieces of equipment for example, on the inside of a tank are being constantly shifted about, removed, or reinserted. The moving of such equipment is usually done with chain hoists with the result that the bottom and the upper edges of the tank receive a great amount of abrasion from the dragging chains, while the walls of the tank received very little wear.

Sprayed coatings of lead have been found of particular advantage in certain industries as a protection against acid corrosion. If, by chance, a hole were to wear through the coating, it is only necessary to clean the small area that is damaged and then spray on a patch of lead. Sprayed zinc is also much used as a protection against corrosion because of its "self-healing" characteristics. Tanks, containers, steel structures, and almost any object that is subjected to atmospheric corrosion, cold or hot water corrosion, or corrosion caused by gases and acids can be protected by metal coatings.

For protection against certain types of corrosion a combination of metals may be applied. Alternate coats of zinc and aluminum placed one on top of the other have been found particularly resistant to the corrosive

Figure VI. Operation of latest type of metallizing equipment.

Figure VII. Building up a press fit for a ball bearing race motor end shield. Very close tolerances are maintained, often eliminating necessity for finishing.

action of gases heavily laden with sulphur dioxide. Alternate coats of lead and zinc have been found resistant to the corrosive action of acidic gases on blower fans. As a protection against heat corrosion, grate bars, gas jets, and other furnace parts in the natural gas equipment industry have been sprayed with aluminum and after-treated, with the result that the life of these parts was increased.

But corrosion protection is only one field of application. The metal spraying processes are widely used in various maintenance, salvage, production, and decorative applications. One finds equipment for this work in machine and welding shops; in the maintenance and salvage departments of large industrial plants; and on the production lines in the automotive, refrigeration, glass, electrical, and general manufacturing industries. In maintenance work, the building up of worn bearing surfaces, rolls, journals, pump rods, shafts, and casings by metallizing, avoids the scrapping of such parts and their replacement with new pieces, often saving loss of time or eliminating expensive shut downs. The variety of metals that can be used by this process permits the spraying of a hard surface for a bearing section or a corrosion surface for a packing section, and so on.

In the paper industry, metallizing equipment has found a unique place in maintenance work,—for restoring to service all types of worn or defective mechanical parts, as well as the "application of corrosion resistant coatings to various types of equipment where corrosion has heretofore been a severe problem," to quote from a paper read by R. A. Axline, before the Annual Meeting of the Technical Association of the Pulp and Paper Industry, in February, 1937. Some specific uses for metallizing in the pulp and paper industry are for coating rolls with brass, cast iron rolls with stainless steel, and for covering beaters, digesters, and washers with cadmium. Rayon producers spray tanks with zinc and tin, while the textile manufacturer coats starch mixers with zinc, size kettles with tin and copper, dye kettles and jog boxes with nickel silver, sulphuric acid wash tanks with lead, and dye cans with tin, all by means of the metal spray process.

In railroad car and locomotive shops, metal spraying is meeting the repair problem for building up piston rods, pump rods, stocker elevator shafts, armature shafts, drive axles, mechanical lubricator shafts, coach axles, main rod brasses, crown brasses, throttle rods, and stoker drive shafts, in addition to the regular maintenance work on the shop machinery.

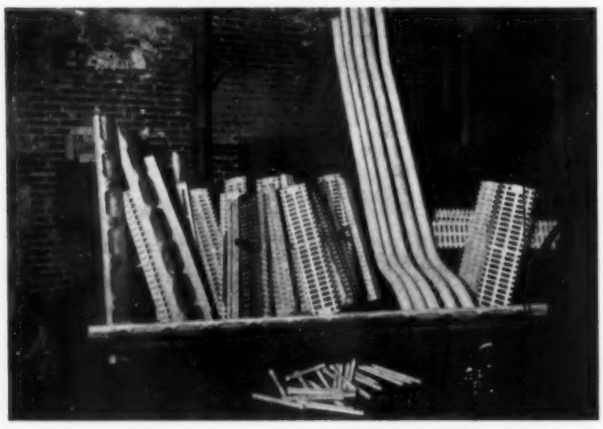


Figure VIII. Locomotive grate bars, arch tubes, and tube supports protected by spraying with molten aluminum. Stay bolts coated with zinc.

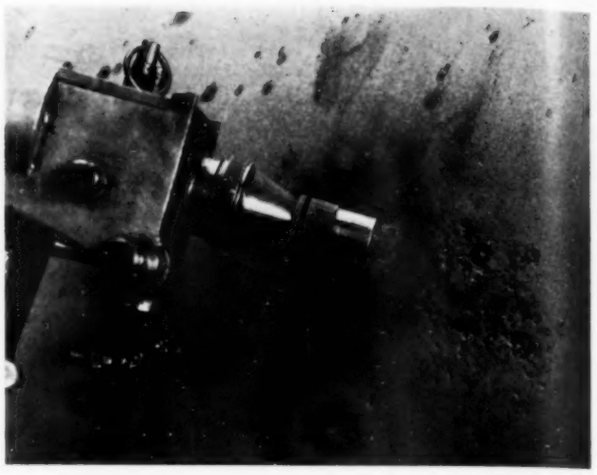


Figure IX. Close-up view, showing defects in cast iron dryer roll. After sand-blasting molten iron was sprayed over the area and ground down to face.

In manufacturing plants, thousands of small pieces, such as nuts, bolts, screws, etc., can be metal coated in one operation. Tumbling barrels are used for sand blasting and also for metal spraying, thereby saving much time and lowering costs.

The metallizing process goes even beyond putting on permanent adherent coatings. By a simple method, detachable coatings may be produced by preparing the surface so that the sprayed metal does not adhere. A shell of the required thickness is thus produced which can be easily lifted off and used as a mould or pattern for duplications. Many other applications might be mentioned but they are too numerous to list here.

After all that has been said, it is only fair to add that metallizing must not be looked upon as a universal panacea for all industrial troubles. There are certain limitations with which the worker or shop manager might well acquaint himself, as otherwise he may meet with disappointments. These limitations, however, are quickly learned, and when known difficulties can easily be avoided. For one thing it must be borne in mind that the bond is purely mechanical; that the tensile strength of sprayed metal is rather low and the compressive strength high. These conditions must be observed in making use of the process. Strict attention must also be given to the preparation of the surface, and no appreciable time should be allowed between the preparation of the article and the actual coating.

EDITOR'S NOTE—The courtesy of the following manufacturing companies in assisting with data and pictures, is greatly appreciated:

Metallizing Company of America, Inc., Chicago, Illinois
Metallizing Engineering Company, Inc., Long Island City, N. Y.
Metals Coating Company of America, Philadelphia, Pennsylvania
Metalspray Company, Los Angeles, California.

Bright Nickel Plating*

By O. A. Stocker

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Seymour, Conn.

O. A. Stocker

A comprehensive, candid discussion of the bright nickel plating processes. Qualifications and properties of bright nickel baths are discussed. Purification of solutions, the effects of impurities and 32 operating hints are listed.—Ed.

Introduction

Bright nickel plating processes command an ever-increasing interest in the metal finishing trade, since they have come into general use during the past few years. While bright nickel deposits have been produced as long as 15 years ago, it is only since heavy bright deposits can be successfully secured that the general interest has grown. Processes that can be operated at high current densities, day after day, on regular production, with freedom from shutdowns, naturally open up possibilities for wide use in the plating trade.

A brief mention of the use of brighteners in cold nickel baths might be of interest. The use of certain gums, gelatins, and sugars in nickel baths gave bright deposits at low current densities but their use was limited to thin plates. Likewise, zinc and cadmium additions produced bright deposits, but such plates were apt to be brittle, and the use of such substances was attended with trouble as the concentrations were very critical. Such home-made bright nickel baths were not particularly successful in production. The modern bright nickel processes, produced after considerable research and experimentation, offer reasonable assurance of high speed bright nickel plating with a minimum of trouble.

In this general discussion, all reference to any particular process will be avoided. They may be classified in two groups, one of which uses only organic compounds to secure the brightening effect, while the other group employs both organic and metallic compounds.

The actual theory of bright nickel deposition is not known, but stated in a simple manner, it is assumed that dull nickel crystals do not orientate themselves perfectly while being deposited, so that the resultant plate consists of a series of microscopic elevations and depressions which can only reflect diffused light, giving a dull effect, while a bright nickel deposit is a flat, mirror-like surface, perfectly plane and free from uneven crystal growth, so that light is perfectly reflected, giving a brilliant, bright appearance. What changes take place at the cathode to produce this, are not exactly known, but it is evident that the addition of certain organics and metallo-organic compounds produce a deposit of entirely difference characteristics than from an ordinary nickel bath.

The mechanism involved in depositing bright nickel crystals on a cathode is probably very delicate and demands, therefore, rigid control of such operations as can be regulated, so as not to interfere with the inherent property of the brightening agent in the bath to produce the uniform nickel crystals necessary to give a bright finish.

It is a fact that bright nickel processes require considerably more care in control and operation than do the dull nickel baths. There is considerable similarity between such processes and the chromium plating bath. Both processes require high current densities as compared to cold nickel plating, hence demand care in racking so that positive contact with the work is assured. In some instances, the rack must be designed to protect against too high a current density on projection and edges, and care must be observed in securing the best throwing power in recesses. Racking of articles too closely must be guarded against to prevent shading, for any change in the color of the bright deposit is noticeable and must be avoided, since there is no color buffing to remove such variations as in dull nickel plating.

There is also a similarity between chromium plating and bright nickel plating in regard to the difficulties attached to the first use of both processes. It requires little searching of the memory to recall that the

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pioneers in chromium plating had lots of grief until familiarity with the process and its control simplified the use. The pioneer users of bright nickel processes likewise were beset with troubles and many a production department was the proving ground for such processes, until both user and vendor acquired the knowledge necessary to make such processes practical. There is no question as to the value of bright nickel plating as regards economy. First of all, the most obvious saving is the elimination of the final color buffing, and the ability to route such work directly to the chromium tanks and to chromium plate on the same rack if desired. Second, the use of high current densities cuts down the plating time and speeds up production. Third, the elimination of color buffing makes rejects due to cutting-through of the deposit on edges and projections a thing of the past. Fourth, the fact that less handling of work will be necessary, cuts the labor cost. Fifth, if for any reason color buffing is found to be desirable, it will be only necessary to lightly wipe a proper bright nickel deposit to get the highest lustre.

Qualifications of Bright Nickel

To properly discuss bright nickel processes, certain qualifications of such deposits should be stated. A bright nickel deposit should maintain its lustre at all thicknesses of plate, and the deposit should be inherently bright. The plate should be ductile, so as to allow mild forming operations on the article plated, without cracking of the deposit. The nickel should be soft and easy to wipe to a high lustre if necessary. The deposit should be free from pores and as corrosion resistant as dull nickel. No treatment should be necessary before chromium plating.

In regard to the baths, they should have certain qualifications. The organic compounds should be stable and not decompose to bring about dullness of plate. The solution should not be too sensitive to impurities, although contamination of a bright nickel bath should be avoided. The operating limits, as regards temperature, current density, pH, and concentration of various ingredients, should be wide. The bath should have good throwing power.

In general, the *baths* used vary in *nickel sulfate concentration* between 20 and 40 ounces per gallon, with *nickel chloride* content between 4 to 8 ounces per gallon. They are well buffered with *boric acid*, generally 4 to 6 ounces per gallon, and the *pH* varies from 2.0 to 4.5 electrometric. Each process has its limits of *temperature* ranging from 85° to about 160° F., with *current densities* ranging from 5 to 120 amperes per square foot. Certain ones will work without *agitation*, others will require constant agitation, and circulation, while others will work equally well in a still tank or automatic tank where the cathode moves slowly.

Figure I. Bright nickel plated parts.

One process may be limited to a very narrow range of *pH*, or *temperature*, or *current density*, while another may have a wide operating range. The *color* and *brightness* of deposits from the various processes differ. The ease of control and stability of each bath differ, as do the ductility and softness of the deposits, all of which are factors to be individually considered and investigated by prospective users of bright nickel.

The preparation of the *base metal* is important, in that all bright nickel deposits are seemingly transparent and any defects in the base metal, such as scratches, pits, or lack of good polishing, are magnified or enhanced. Preparation of the base metal must of necessity be better than for dull nickel, for in the absence of the nickel coloring operation, the final coloring should be on the base metal.

Bright Nickel on Various Base Metals

For deposits on the order of .0002″ of bright nickel directly on a base metal, the final finish in the base metal should be a color buff. This applies particularly to copper and brass, which do not need a very heavy coat of nickel to withstand corrosion. For zinc die-castings which require a much heavier plate for corrosion resistance, the polishing operation need not be so fine, since such a base metal requires a preliminary deposit of copper or dull nickel before bright nickel plating, and deficiencies in the base metal preparation are somewhat covered up. Steel articles having a good rolled finish need not be polished as the bright nickel deposit will be over 0.0005″ thick, while for high grade steel articles, a fine polish is desirable to remove such imperfections as pits, cold shots, inclusions, and scratches. Sheet metal stampings, free from die marks, can be bright nickel plated without preliminary polishing, and a good finish secured. Bright dipped brass can be bright plated although it requires about a minimum of 0.0002″ to effect a good finish on a matte surface. Articles made of wire can be plated with a good bright surface without preliminary burnishing, since a round surface with a small diameter will not show imperfections as a flat surface will.

Most bright nickel deposits attain an increased lustre as the *thickness* of the deposit increases, which is very desirable. Some processes can be applied directly over unbuffed copper deposits and good bright plate secured. *Zinc base die-castings* are plated in this manner, using about 15 minutes of Rochelle salt copper with a thickness of 0.0003″ to 0.0005″ copper. *Zinc base alloys* cannot be plated directly in any bright nickel bath, due to the low pH used, and the preliminary copper deposit must be free from pores and must completely cover the zinc alloy to avoid contamination of the bath. Die-cast nickel can be the undercoating, as it has good adherence, and a proper bright nickel will adhere to the dull nickel deposit.

Properties of Bright Nickel

The matter of *adherence* of bright nickel deposits is important, and on this subject it must be said that the adherence, which varies with the type of bright nickel, is not quite as good as that of dull nickel. To secure the best adherence sometimes involves some changes in the cleaning cycle. Properly cleaned, bright nickel can be deposited in thicknesses of 0.001″ and over directly upon steel and undergo severe bending without any separation. Over copper and brass, the problem of adherence is not as critical.

The *ductility* of bright nickel varies with the process and conditions, and the plate may be extremely soft and ductile, or under improper deposition, it may be brittle. This characteristic may be found in both classes of processes, and it is not found specifically in the so-called "alloy" plates. Excess of organics may cause brittleness. Properly deposited, bright nickel plate will be found to be capable of mild forming operations without cracking. As compared to dull nickel deposits, the ductility of high current density deposits is somewhat less.

The *cathode efficiency* of bright nickel processes varies from about 90 to 98%. Any tendency to gas with resultant pitting is avoided in most cases by the use of organic anti-pitting agents, which have the property of lowering the surface tension of the bath down to a point where the gas bubbles will not adhere to the work being plated, but go sliding off because of their buoyancy with the resultant absence of gas pitting. Hydrogen peroxide cannot be used with the majority of bright nickel baths as it destroys the organic compounds in the bath.

In regard to *cleanliness* of the baths, it is important in all high current density plating that no foreign particles, however minute, be allowed to float about, because they will be attached to the cathode with resultant rough plate. It is necessary to filter a bath when rough plate does occur. In most processes, this operation entails no trouble, although a filtering apparatus, suitable for low pH baths, is generally necessary to prevent contamination of the bath by foreign metals. Baths must be kept free from oils and greases by proper precautions.

Purification of Baths

Bright nickel baths are more sensitive to *impurities* than dull nickel baths, and they must be guarded against contamination from foreign metals and harmful organics. Copper, iron, lead, etc. in amounts less than 0.01 ounces per gallon will cause trouble, such as darkening of the deposit in recesses, and possible embrittlement of the plate. Organic impurities, such as might come from buffing compounds left on work, or from organic substances absorbed from a rubber tank lining which was not compounded for a hot organic type bright nickel bath, will cause fogging of the deposit or brittleness. Such impurities can now be removed by proper treatment, and their presence does not mean the dumping of a bath, as it formerly was necessary to do. It is important to select the proper rubber lining for the process

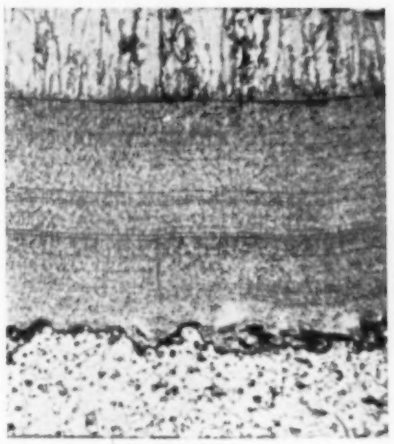

Figure II. Etched micro-section of bright nickel deposit showing banding. (After Hothersall).

intended to be used, and in this matter, the supplier of tanks should be specifically consulted. A rubber lining compounded for a cold nickel bath, or for an acid dip tank, may poison a hot organic bright nickel bath and cause considerable trouble.

Bright nickel baths containing wetting agents have a very low surface tension of about 32 to 37 dynes per cm. Grease from any source, as from buffing compounds left on work, will not float to the surface to be skimmed off and removed, but will be incorporated in the bath to cause lack of adhesion or fogging of the plate. Organic impurities introduced by the breaking down of the original brightening agent may cause loss of brilliance. The only possible manner in which to remove organic impurities is to treat the bath by continuous filtration for a time through a filtering apparatus charged with a suitable activated carbon, which has an affinity for such materials. The details of such treatment are given in an excellent article by Mr. Helbig in the METAL INDUSTRY of December, 1938, so that the details will be omitted here. To remove substances such as mineral oils or lubricating oils, a similar treatment with an activated clay is required.

Metallic impurities can be removed by dummy plating of a bath using a cathode current density of 2 to 4 amperes per square foot or by raising the pH to over 6.0 with lime and nickel carbonate, adding hydrogen peroxide, and filtering.

In regard to *filtration* and *purification* of the bright nickel bath after installation, each bath is affected in a different manner, some losing certain of their brightening constituents through ordinary filtering, and others being affected by a purification requiring dummy plating at low current densities or raising of the pH to above 6.0 with lime and nickel carbonate. Loss of brightening agents through just ordinary filtration is somewhat of a costly factor, as the bright nickel baths must be kept clean and may occasionally require frequent filtration. The loss of brighteners through purification treatment is not so much a matter of concern, for if the bath is properly controlled and kept free from contamination, such purification should not be required.

In regard to the necessity of a clean bath, the subjects of proper *anodes* and anode bags are pertinent. Bright nickel baths operating as they do from a pH of 2.0 to 4.5 in hot solutions at high current density, demand anodes different from those used in high pH, cold nickel baths. While almost any anode will corrode under such conditions as present in the bright nickel bath, with a fairly high chloride content, most anodes do not corrode or dissolve completely without the formation of loose undissolved particles of nickel, which are sometimes so fine that they get through the anode bags into the bath, with subsequent rough plate. A proper anode for such baths is one that will dissolve with high anode efficiency, at high current densities, with no

loose nickel formed, and with the least formation of necessary non-metallic sludge. The anode sludge should be of a nature that it will be retained inside of the anode bags, and not so fine that it will seep out into the tank. The bags must be made of heavier material than used in cold solutions, must be of unsized material, and must be resistant to disintegration from the acid baths. The bags now available for use include woven glass bags, bags comprising an outer cloth bag and an inner filter paper bag, and bags of cloth only, selected to meet the necessary requirements.

The *throwing power* of bright nickel baths is a factor of interest, and while it is generally true that dull cold baths have perhaps better throwing power, certain bright nickel processes have the ability to deposit bright plate in recesses of appreciable depth. This property varies with the process, and it is conceded that a hot nickel bath is slightly inferior to a cold bath in this respect. The throwing power appears to be benefitted by high current density and high nickel content. Violent agitation of the solution or rapid agitation of the cathode affects this property adversely, but satisfactory results in production are secured with several processes on articles requiring excellent throwing power.

Regarding control of a process, it is decidedly advantageous to be able to check the concentration of the brightener by a simple analytical method, as it avoids visual control, where the need for brightener additions is indicated only when several racks of work have come out of the bath with reduced brilliance.

Bright nickel plating has a definite field in the metal finishing industry, but it cannot work miracles. Its application to a particular plant must be studied and carefully considered before an installation is made. On base metal of poor finish, as on goods selling cheaply in a highly competitive field, where polishing of the base metal is not a part of the cycle, the imperfections will be visible. A very passable product may be secured by depositing a thin coat of copper followed by a light coloring operation, and finished with bright nickel. On articles having a preliminary polishing and coloring operation before plating, followed by bright nickel, very satisfactory results are secured. On articles requiring a highly finished surface, bright nickel does an excellent job, since such articles are highly polished before being bright nickeled. The main savings attached to bright nickel plating is the elimination of the final coloring before chromium plating and the elimination of the handling and drying of the work between the nickel bath and the coloring operation. In many cases the final coloring is eliminated but an additional coloring before nickel plating is required. The savings are concrete, since it must be borne in mind that because no coloring is done on the bright nickel, less plate is required as there is no danger of work being cut through on edges, corners, and projections. As a matter of fact, such points, formerly the cause of rejects, receive a heavier plate than the central flat areas of a piece, which gives added protection. With dull nickel, 20 to 30% additional thickness of nickel must be put on to allow for cutting down in the coloring operation.

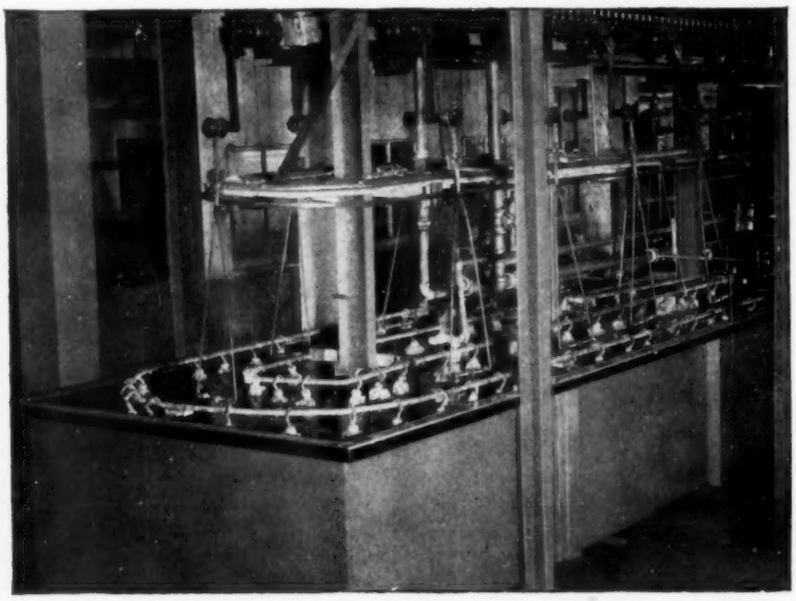

Figure III. Automatic bright nickel installation at Fitzgerald Mfg. Co., Winsted, Conn.

We have drawn up a list of precautions which should be observed in the operation of a bright nickel bath, many of which are general knowledge, but which we all need to be reminded of occasionally.

1. *Use only a tank that has a rubber lining approved for use with hot organic bright nickel baths.*

This is of extreme importance, as stated before, since considerable trouble can be caused by organic contamination. It requires only a very small amount of an organic substance to give a bath bright properties, so that it is obvious an equally small amount of a harmful organic may cause trouble.

2. *Use only properly cast 99% Plus anodes preferably, or rolled depolarized anodes, bagged with suitable heavy, free from sizing bags. If anodes have been used previously in another bath, they must be absolutely clean before use in a bright nickel bath.*

The proper anodes and bags should be recommended by vendors of each process.

3. *Use only lead heating coils placed at ends of tank, and NOT behind anodes. Keep anodes at least a foot away from coils so that the lead will not act as an anode.*

Lead heating coils appear to be most suitable for low pH baths. Since there is a high chloride content in most bright nickel baths and lead chloride is soluble in hot solutions any effort to keep the lead from dissolving is worthwhile.

4. *Use only pure nickel hooks on anodes and keep solution level below tops of anodes.*

Since most nickel anode hooks are of monel metal an alloy containing nickel, and copper, there is a possibility of some anodic solution of such hooks, resulting in copper contamination of the bath with resultant trouble.

5. *Use all of the Make-Up sent for the installation, dissolving out any semi-solid matter left in the carboys with hot water, and when dissolved, adding the solution to the bath proper.*

In converting a bath into a bright nickel bath, in the absence of a process representative, it is wise to follow instructions implicitly.

6. *Use water that is not dirty or rusty*

for making up or raising level of the bath.

Such water is an easy source of contamination and should be avoided.

7. *Use care to be sure that the anode and cathode bars and the steam coils are electrically insulated from one another and from the tanks.*

This precaution is important to prevent shorts, and to guard against the lead coil becoming anode or cathode.

8. *Do not leave work suspended in bath for long periods of time with no current flowing, as some dissolving of the base metal may take place.*

This is another precaution against bath contamination.

9. *Do not rack in haphazard fashion. Attention should be given to securing firm and clean contacts, as in chromium plating, so as to insure minimum gassing, minimum burning at corners and edges, and maximum throwing power.*

Self-explanatory. High current density demands better racking.

10. *Do not plate over stripped work unless the previous deposits have been completely removed.*

A precaution against peeling of the subsequent plate.

11. *Do not forget to recover immediately all articles lost or dropped in the tank.*

A precaution against bath contamination.

12. *Do not expect bright nickel to adhere to unclean surfaces; dull nickel does not.*

A clean surface before plating is extremely important, as stated before, since the adhesion of bright nickel is slightly inferior to that of dull nickel.

13. *Do not stir bath just before using as rough plate may result from sediment put in suspension. Stir bath at night after plating has stopped.*

This applies to all plating baths.

14. *Do not fail when cleaning anode bars to keep paper underneath so that metal and emery dust will not fall into the bath, thereby contaminating it.*

Another precaution against solution of foreign metals.

15. *Do not fail to keep anode bars covered so that dripping solution will not dissolve copper into the bath.*

As above.

16. *Do not use a filtering apparatus which has iron or copper alloy in the system.*

A filtering apparatus for low pH baths should be made of metals not soluble in such solutions. All parts in contact with the solution should be of a corrosion resistant alloy or metal, or covered with a proper rubber covering. This excludes copper, brass and plain iron or steel.

17. *Do not forget to avoid contamination of the bath from leaky steam coils, dust and dirt in the air, and dirt carried into the bath from work not properly cleaned. All bright nickel baths are sensitive to impurities.*

Leaky steam coils are a source of iron contamination.

18. *Do not get any chromic acid into the bath.*

Chromic acid causes peeling in any nickel bath. Racks used for both bright nickel and subsequent chrome plate should be carefully washed before going through the cycle again.

19. *Do not use ammonia or ammonium salts; raise pH with nickel carbonate.*

Ammonia or its salts have a tendency to cause brittle deposits in most hot nickel baths, with the exception of one process which uses it in the formula.

20. *Do not forget to keep within operating limits set in the Instruction Sheets, unless otherwise specified.*

This is important as a means of proper control.

22. *Do not fail to check pH and temperature first in case any variation in plating occurs.*

Most troubles in bright nickel solutions occur from a gradual change of pH until it is outside the proper range, or from a sudden rise or fall in temperature.

22. *Do not expect the bath to operate satisfactorily when analysis shows factors off standard.*

Proper concentrations of all ingredients produce most satisfactory results.

23. *Do not add replenishment solutions unless when indicated by analysis, or advised by the laboratory. Do not experiment with the bath.*

Self-explanatory.

24. *Do not fail to see that all additions are diluted with ten times their volume with a portion of the bath outside the tank before adding to the main bath.*

Advisable for most processes to insure proper mixing.

25. *Do not forget that as the brightener content increases, the current density may be slightly increased.*

26. *Do not use any type of violent agitation and bear in mind that any agitation demands increased current density.*

27. *Do not allow the anode area to become too much decreased by failure to replenish with new anodes, as the current capacity of the tank will also decrease.*

Very important as the current capacity of a bath is limited by too small an anode area. Likewise the nickel content will decrease.

28. *Do not fail to purify all nickel salts added to the bath.*

All nickel salts contain small amounts of metallic impurities, and in concentrated baths enough may be present to cause trouble. Purification of nickel salt is of value even for dull nickel baths.

29. *Do not forget to hang freshly plated dummies in tank overnight to plate out any copper in the bath. This can be done without current flowing.*

Copper plates out readily by immersion on nickel plated dummies and this is a means of removing it.

30. *Do not fail to control amperes when loading or unloading tank.*

Since all plating processes have a definite range of C.D., this must be controlled.

31. *Do not fail to contact the laboratory at any sign of trouble.*

Self-explanatory.

32. *Do not blame the PROCESS for every difficulty met with in its use, as most trouble is caused by something prior to plating, such as improper cleaning, improper racking, etc. Keep in mind that bright nickel plating, like chromium plating, must be properly controlled to produce the best results.*

In conclusion, I would like to state that there is a very definite use for bright nickel as evidenced by the many successful installations in operation.

Figure IV. Bright nickel requires careful preparation of base metal. Polishing iron tops.

As knowledge of the operation of such processes increases, the applications will increase until its use will be general where savings can be effected. Service by technical men will undoubtedly be required from time to time, so that the availability of such service is of prime importance to the user.

The natural trend of the finishing industry will be toward securing better finished base metal and modern equipment, so that the adoption of a bright nickel process with its evident economy will not involve the heavy initial expenditure it now requires in so many plants.

A Review of Finishing Methods*

Gustave Klinkenstein

By Gustave Klinkenstein

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The author reviews the modern methods of applying lacquers and enamels. Factors to be used in deciding the methods of applying finishes are discussed. Brushing, roller coating, tumbling, centrifuging, hand dipping, machine dipping, gasket coating, manual spraying and automatic spraying methods are described. —Ed.

Lacquers and enamels can be applied to metal products in a number of different ways, of which the most important are: brushing, roller coating, tumbling, centrifuging, manual and mechanical dipping, gasket coating, and manual and automatic spraying.

Each of these methods can be used for finishing a wide variety of products, but the problem of selecting the method that will satisfactorily finish a given product at the lowest unit cost is by no means a simple one. A large number of variable factors is involved, and the wrong answer may mean high costs, inferior results, and, perhaps, a wasted investment. Hence, each case should be carefully analyzed before the finishing method is selected.

Some of the factors that influence the selection of a finishing method are as follows:

Quality of Finish—There are some differences in the quality of the finishes that the various methods will produce. Thus, one can not expect to get a very high grade finish by tumbling. In general, however, the more important finishing methods are all capable of producing results of the highest order. But it is important to remember that good results can be obtained only when the finishing material used is designed for the method of application. Finishes of very different characteristics may be supplied for dipping, spraying, roller coating, and other methods.

Character of Finish—Products to be given a single colored or clear final coat can be finished by any method, but as the number of colors to be applied increases, the number of available finishing methods decreases. If a large number of colors is wanted, either brushing or manual spraying must be used. Spraying is the only method by which wrinkle finishes and many of the novelty finishes can be applied.

Size, Shape, and Weight of Product—The physical characteristics of the product have to be taken into consideration. For example, solid brass balls can not be tumbled, small thin discs can not be centrifuged, plates that are not flat can not be roller-coated, and often, objects of irregular shapes can not be dipped.

Volume of Production—It would be manifestly absurd to install an automatic dipping or spraying system to finish a few dozen small products a day, and equally absurd to attempt to finish 10,000 compacts an hour by brushing. However, in many cases only careful calculations can determine whether a finishing system that can be installed for a small outlay or one requiring a large investment will prove the more economical in the long run.

Finishing Facilities Available—Naturally, a manufacturer who has certain finishing facilities available will use them, if possible, for finishing a new product, especially in the early stages of production when the output is small. This may prove poor economy, however, and no finishing method, however convenient, should be employed for any length of time unless it is justified by a careful engineering analysis of costs and results.

Material Handling—It often happens that, in laying out a finishing department, the chief problem to be solved is one of material handling. This purely mechanical matter may govern the choice of the finishing method to be used, since certain methods are better adapted to certain material handling systems than are others.

Labor Requirements—Though every finishing method is, inherently very simple, a high degree of skill and experience are required to secure good results with any of

*An address delivered before the annual convention of the American Electroplaters' Society held at Asbury Park, N. J., June 19-21, 1939.

them. The availability of skilled operators is, therefore, a factor to be considered in selecting any finishing method.

It is evident that there is no best way of finishing any product but that preference must vary with circumstances. There are, however, certain kinds of operations for which each finishing operation is best adapted, and these will be reviewed insofar as this can be done in a short time.

Brushing

Brushing is used to finish industrial products when the production is too small to warrant any investment in finishing equipment, but it is also employed in mass production operations for certain special cases where no other finishing method is altogether satisfactory. For example, the metal parts of a glass door-knob assembly are finished as follows: The units, which are handled mechanically throughout the process, pass before an operator on a turntable. Each unit is rapidly rotated on its long axis, and the operator applies lacquer to the metal parts by pressing a brush against them. After lacquering, the units go into an oven where they are dried.

Brushing lacquers must be more viscid and slower drying than those used for dipping and spraying. If large surfaces are to be covered, considerable skill is required in order to secure a satisfactory finish.

Roller Coating

Roller coating machines, which apply the finishing materials to the work by means of rolls, are widely used

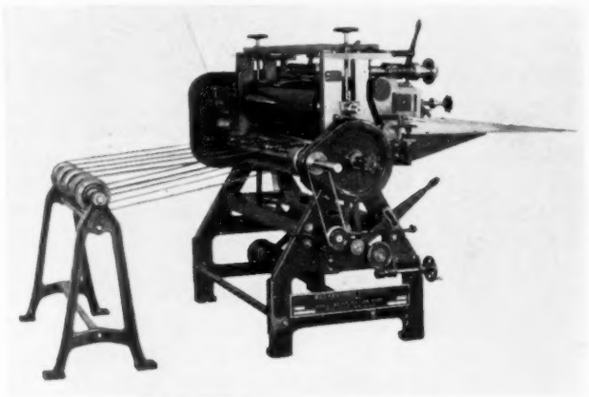

Figure I. Machine for applying lacquer, paint, varnish and japans to sheet materials. (Courtesy Rutherford Machinery Co., N. Y.).

for finishing flat plates and sheets of uniform size and thickness because this finishing method is undoubtedly the cheapest of all, where applicable. A roller coating machine can handle stock, stiff enough to be gripped by the rolls, up to 1 inch thick, 44 inches wide, and of any length. It can coat 75 linear feet a minute and can be adapted to any volume of production by suitable mechanization. The wastage of finishing material is small, being chiefly confined to that lost in cleaning the rolls. In consequence, the coverage per gallon of finishing material is much greater with roller coating than with other methods which are inherently more wasteful of material. The thickness of the applied coating can be varied over a wide range, and when the machine is set for a given film thickness, this will be maintained with great accuracy until a change is made by the operator. The coating is evenly applied over a wide surface and, if desired, can be given an unusually high gloss. By using cut-out rollers, various designs can be applied.

The coating of thin sheets for the sign and can industry is done principally by roller coating. A base coat is applied by the machine, and this is followed by the application of printing or art work by lithographic or silk-screen methods, depending upon the production volume. If a high gloss is desired, a top coat is applied by the roller coater.

Varnish and synthetic enamels are generally used for

Figure II. Japanning barrel. (Courtesy The Baird Machine Co., Bridgeport, Conn.).

this class of work. Lacquer, due to its tendency to penetrate and pick up between coats, has found only a limited application.

Cylindrical products with smooth surfaces, such as flashlight tubes and the collapsible tubes used for tooth-paste and the like, are also often finished by roller-coating machines. A horizontal mandrel holds the product horizontally in contact with the moving rolls, which impart their motion to the product and coat it with the finish. The products can also be printed and top-coated by similar machines, and the whole process can be completely mechanized.

A special use of roller coating is in the finishing of automobile license plates. The plates are first dipped to apply the base color and are then run through the roller coating machine which applies the second color to the raised lettering.

Finishes of all kinds can be supplied for use on roller coating machines, but they must be specially formulated for this application. This is particularly true when products are to be stamped, or otherwise formed, out of the finished sheets.

Tumbling

In tumbling, products are finished by rolling them for from 15 to 30 minutes in a revolving barrel with a small quantity of finishing material which is either poured into the barrel or sprayed on the products. After tumbling, the products are spread out on wire screens before baking. It provides a simple and easy method of finishing small, light metal objects that are so shaped that they will roll over each other when the barrel is revolved, like buttons, springs, hooks and eyes, and non-solid castings. Solid metal balls, cubes and other heavy articles can not be finished in a tumbling barrel, because, on account of their weight and hardness, they will merely polish. On the other hand, hollow balls and the like can be successfully tumbled.

Originally, tumbling gave a low-grade finish, but by using finishing materials specially developed for this purpose, fairly even coats, free from blotches and marks, can be obtained. It is stated that a tumbled finish, being well worked into the surfaces of the products, is less liable to flake or chip off and will withstand harder usage than a dipped finish.

The thickness of the film that can be applied by tumbling is limited. If heavier films are wanted, the products are re-tumbled after the first coat has been baked on. This process can be repeated several times, if desired.

Centrifuging

Where production is great enough to warrant the cost of the necessary equipment, centrifuging will be found to be one of the most economical methods of finishing products adapted to the method, because the work is done so quickly, so little of the finishing material is wasted, and the resulting finish is so even and durable.

Figure III. Centrifugal enameler. (Courtesy Ronci Machine Co., Providence, R. I.).

In this process, as carried out by one type of machine, the products to be finished are placed in a basket in the upper part of the centrifuging machine and the cover is clamped down. The basket is first lowered into a tank of finishing material located in the lower part of the machine, then raised, and finally rotated at high speed first in one direction and then in the other. This rapid spinning and quick reversing forces the finishing material into the pores of the products under considerable pressure, returns the excess material to the tank, and insures an even coat free from indentations. After centrifuging, the basket is removed and the products are dried in an oven or otherwise.

The process is a very rapid one. Twenty loads, each consisting of, say, 3,000 shoe buckles, can be centrifuged in an hour. Since the finishing material is applied under high pressure, it adheres well and is less subject to checking and flaking than a finish applied without pressure.

Centrifuging is applicable to metal stampings, springs, toys, buttons, bottle caps, castings, pencil ferrules, dress snaps, hair pins, curtain fixtures, and almost all other small metal products. The exceptions include those that are perfectly flat, those that tend to nest together, and those so shaped that they pocket some of the finishing material. However, by manipulating the machine in special ways or placing the products on special racks, some of these products can also be centrifuged. Large, symmetrical disc-shaped products, like certain types of automobile wheels, can be finished individually in this way when properly racked.

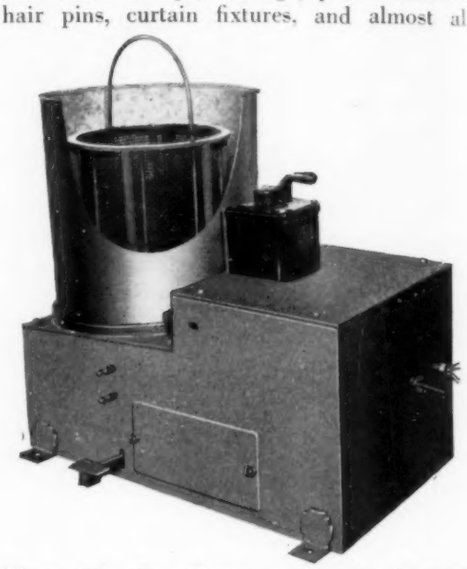

Figure IV. Centrifugal machine for lacquering small parts. (Courtesy Dellinger Mfg. Co., Lancaster, Pa.).

Both baking and air-drying lacquers, enamels, and synthetics can be applied by centrifuging. All of the materials must be sufficiently viscous to withstand the centrifugal action of the machine and to carry enough pigment to give thorough coverage.

Hand Dipping

Because of the simplicity and low cost of the equipment required, the hand dipping method is frequently used for finishing limited numbers of products that are not too heavy or too bulky to handle. However, since the process must be carried out with large open tanks of finishing materials, there is an excessive loss of solvents by evaporation, the finishing material is liable to become contaminated by shop dust and dirt, and the fire hazard is high. Hence, the modern tendency is to favor other methods wherever possible.

Large objects are dipped singly, and small ones are handled by mounting them on racks or placing them in wire baskets.

The finish used in this process must have a high solid content but must be very thin so as to flow readily off of the products when removed from the tank. Great care must be taken to prevent the formation of blisters caused by air bubbles carried into the lacquer by the product, and to drain off the excess of material properly so that a uniform coating will be formed without runs, wrinkles, "tears," or "fat spots."

Machine Dipping

With the single exception of spraying, machine dipping is the most widely used of all finishing methods. Almost any kind of product from dress snaps to automobile fenders can be machine dipped, the process is suited to either small quantity or mass production, finishes of the highest quality can be obtained, and the fire hazard can be rendered negligible.

About the only kinds of products that can not be machine-dipped are those having large, flat surfaces to be covered, those to be finished on one side only, those that can not be racked, and those that would be injured by immersion in the finishing material. Articles of irregular shape sometimes cause difficulty, but, when production is large enough to warrant the expense, special equipment can often be devised to dip such articles.

Probably most dipped products are finished in a single color, but even such small products as buttons and beads can be finished in three or more color effects. All ordinary clear and colored lacquers and enamels as well as many different kinds of novelty finishes, can be applied by dipping.

Mechanical dipping equipment ranges from outfits that handle a few products at a time to continuous systems handling thousands of items per hour.

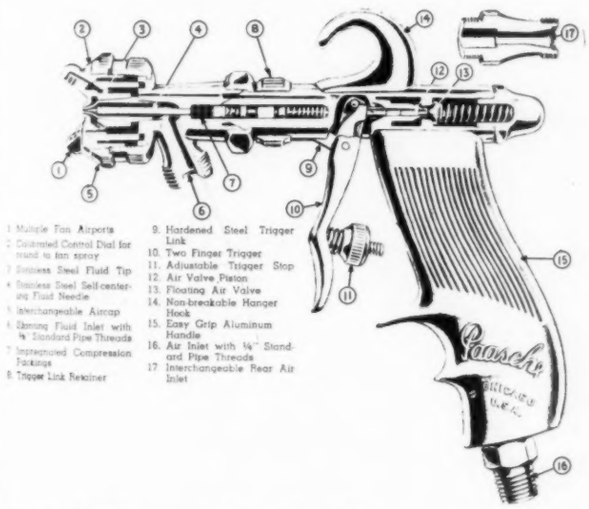
1. Multiple Fan Airports
2. Calibrated Control Dial for round to fan spray
3. Stainless Steel Fluid Tip
4. Stainless Steel Self-centering Fluid Needle
5. Interchangeable Aircap
6. Cloning Fluid Inlet with ¼" Standard Pipe Threads
7. Improved Compression Packings
8. Trigger Link Retainer
9. Hardened Steel Trigger Link
10. Two Finger Trigger
11. Adjustable Trigger Stop
12. Air Valve Piston
13. Floating Air Valve
14. Non-breakable Hanger Hook
15. Easy Grip Aluminum Handle
16. Air Inlet with ¼" Standard Pipe Threads
17. Interchangeable Rear Air Inlet
Paasche

Figure V. Cut-away view of modern spray gun, showing intricate parts.

In a simple type of dipping machine, the products, carried by a rack, are merely lowered into the lacquer and then withdrawn. The machine is operated by hydraulic, or electric power; both the down speed and the up speed can be regulated to suit the job being done; and the control can be actuated manually or automatically. The racks can be placed in the machine and removed by an operator or they can be handled by a conveyor system.

In a patented dipping machine, this operation is reversed. The racked pieces remain stationary and the lacquer tank is raised and lowered. This method produces unusually good results.

In this, and other dipping machines, certain precautions must be observed. The speed of immersion and the physical characteristics of the lacquer must be such that no air bubbles are carried into the lacquer by the products. The speed of withdrawal must be so slow that the excess lacquer drains off smoothly and evenly by capillary attraction and without dripping from the ends of the products. During and after withdrawal and until the lacquer has hardened, the products must not be subjected to air draft or vibration, since either will cause the lacquer coating to be applied unevenly or wrinkle.

Continuous dipping systems are employed only in mass production operations and are usually specially designed for each product to be finished. The principal part of the system is a conveyor of some description which transports the products on racks, passes them through a bath of finishing material, and then through a drying oven. In some cases, the products pass through a succession of baths and ovens. When the products come out of the oven, they can be handled for packing or for further processing. Though the first cost is high, equipment of this kind when properly designed, can finish many kinds of products at the lowest possible unit cost. Almost any kind of finish can be applied in this way except the few that must be applied with the spray gun.

Gasket Coating

This is a special form of dipping, applicable only to pencils, broom handles, curtain rods, wire, and other long products of uniform cross section. In this process, the product after being dipped in the finishing material, or, in the case of wire, passed through a bath, is pressed through a close fitting gasket of rubber, felt, or steel, which wipes off the excess of finish and assures a very uniform coating. Where a very heavy coating is required, as on certain pencils, the product is passed through the process many times. With large output, the whole process can be completely mechanized, and carried out very economically.

Manual Spraying

Spraying is, of course, the most important of all finishing methods. More than 75% of all industrial finishing is done with the spray gun.

Some of the more important advantages of spraying are as follows:

It can be used for finishing almost any kind of metal product, from hairpins to railroad cars.

The initial investment for an outfit is low.

It is economical whether used for finishing a few products a day or in mass production.

Every kind of finish, from the thinnest lacquer to the heaviest asphaltum emulsion, can be applied by spraying. There is no limit to the number of colors nor the kind of decoration that can be employed, and many popular decorative effects such as wrinkle, suede, and veiling finishes, can be obtained only by the use of the spray gun.

With proper safeguards, the fire hazard is small.

The physical limitations to spraying are few—very rarely is a product encountered that is so shaped that the spray can not reach all the surfaces to be finished, and there is no type of finish that can not be produced by spraying. However, it is not always able to produce as uniform a coat as some more mechanical process, and it is not always the most economical finishing method, especially in the case of very small products—it may be

wasteful both in time and in finishing material as compared to some other method.

Hence, while spraying is usually to be considered first when selecting a finishing method, it should not be adopted until the alternative methods have also been studied.

Rapid developments are still taking place in the spraying field. New types of guns are constantly being designed to do new kinds of work, or old kinds more efficiently, and the demand for more and more speed in finishing is being answered by equipment that produces results undreamed of a few years ago.

The circulating paint system is a development of special interest. In this system, each finish is mixed in large tanks at a central point and then circulated through a pipe to all spraying booths. In some systems, as many as twenty different kinds of finishes are thus piped to the sprayers, who merely attach their guns to the outlet supplying the particular finish they wish to use. This system saves time, labor, space, and material in many different ways. Its great advantage from the finishing standpoint is that, since all finishes are mixed in large quantities by a single authority and the operating conditions in each spray booth can be uniformly adjusted, perfectly

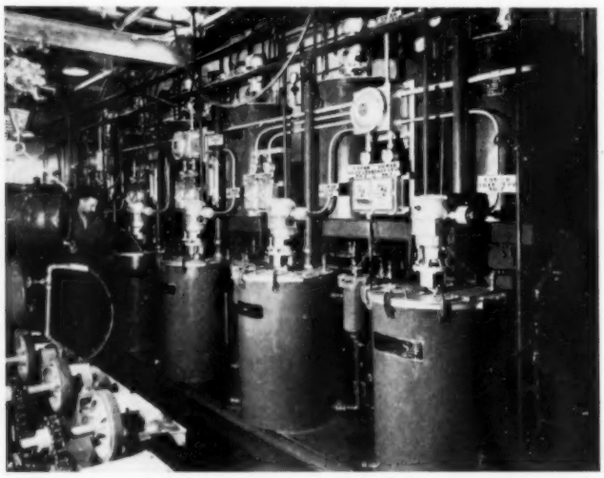

Figure VI. Group of mixing and circulating tanks arranged one above the other and method of handling paint drums, suspended from traveling hoist, when filling containers.

standardized finishes can be obtained.

Another very interesting development is the use of hot lacquer. In this process, lacquer which has been heated to 150° or 160° Fahrenheit, is sprayed on the product with a special gun. Neither the product nor the gun has to be heated, but the gun must be so designed that the lacquer circulates through it without having a chance to cool down.

The object of heating the lacquer is to reduce its viscosity. This permits the use of lacquers having a higher solids content that is possible with lacquers applied cold, and this, in turn, permits the production of thicker films. The increase in the solids content ranges from 25% to 50% and the increase of film thickness may be as high as 100%, so that one coat of hot lacquer may equal two coats of cold lacquer.

The advantages of hot lacquering are, in the first place, a reduction in the finishing time, and secondly, the production of lacquer films that are comparable in build-up with films of synthetic enamels and retain the special advantages of lacquer, namely, rapid drying and hardening, easy sanding and patching, and brilliance and clarity of color.

Automatic Spraying

Automatic spraying is applicable when identical products, large enough to be individually handled, are turned out in large numbers. A large variety of products is now being sprayed automatically, including small products, such as lipstick holders and compacts, large, heavy products, such as electric motors and steel barrels; and flat products, such as sheet metal and refrigerator panels.

For small, light weight products, the rotary spray-finishing machine is largely used. In a typical installation, the products are carried on vertical, rotating spindles which are mounted on a turntable. As the turntable revolves, each product, revolving rapidly on its spindle, is carried past an automatic spray gun, which emits a jet of finishing material that covers the product completely. The turntable then carries the product through a drying oven, and, when they emerge, they are dry enough to handle. Thirty-six hundred products an hour can be handled by a machine of this type.

Sheets and panels are sprayed by machines with automatic spray heads arranged to move horizontally back and forth over the work, while the work moves forward, or with the spray heads carried on a planetary crank mechanism. This method is applicable for coating products or for applying types of finishes that can not be handled by roller-coating machines. Two hundred and forty square feet of surface a minute can be coated in this way.

While many automatic spraying machines are fairly simple in construction and operation, others perform a variety of operations and employ a multiplicity of spray heads to provide multi-color effects or to coat every surface of a product.

Automatic spray machines are usually designed individually for finishing a given product. Their first cost is relatively high, but with large production, their unit operating cost is very low.

The Finish is a Part of the Machine

In closing this review of finishing methods, I want to stress the constant progress that is being made in the art of industrial finishing. Manufacturers of finishes are constantly developing new products to meet new needs and to secure new economies, and manufacturers of finishing equipment are keeping pace by developing new devices to apply to new finishes.

In consequence of this close cooperation, the finish has become as much a part of the finishing machine as any mechanical member of it and must be as carefully designed to perform its proper function. To use the wrong kind of finish may result in disaster. Hence, in selecting a method of finishing a given product under given manufacturing conditions, you should always consult the advice of both the manufacturer of the equipment and your supplier of finishes before making a definite decision.

PLATING AND FINISHING
FABRICATION — ASSEMBLING
METALLURGICAL — ROLLING
CASTING AND JOINING

SHOP PROBLEMS

Technical Advisors For August Issue

L. A. CRITCHFIELD
Electrochemist
Hamilton Watch Co.
Lancaster, Pa.

G. B. HOGABOOM, JR.
Consultant in Electroplating and Metal Finishing,
Newark, N. J.

GEORGE MUSCIO
Consultant in Metal Finishing
Waterbury, Conn.

When sending solutions for analysis please give following information: name and address; class of work being plated; kind of solution and volume; length, width and depth of tank; temperature of solution; current density, cleaning sequence and any other pertinent facts.

Full information is necessary in order to render proper service.

Satin Finish on Stainless Steel

Q. I would like to know how to get a satin finish on stainless steel and also on nickel.

A. Satin finishes on metals are most readily obtained by buffing with a greaseless buffing compound applied to a soft buffing wheel, usually a loose muslin buff. The texture of the finish can be varied by the grade (or grit size) of the greaseless compound and also by the softness and surface speed of the buffing wheel used.

On articles made from stainless steel sheet or strip metal, a satin finish can be produced in one operation by the use of a No. 180 or No. 220 grit greaseless buffing compound on a 64/68 loose muslin buff at 4000 to 4500 surface ft. per minute.

On nickel plated articles, it is generally best to produce the satin finish in two steps. The first operation is performed on the basis metal in the same manner as described above for stainless steel. The article is given a fairly heavy nickel deposit, say 0.0005" and then given a second greaseless compound operation using a finer grit compound and a softer buff, such as a 1 to 1 packed muslin buff at about 4000 surface feet per minute.—G. M.

Gold Dip Finish on Atomizers

Q. Can you give me any idea how long a gold dip finish should last without tarnishing, on atomizers? The parts are not lacquered and after four to six months they develop a brownish tinge in spots. Is this the fault of the coating or is too much expected of it, without lacquering it?

A. To answer your question on how much to expect from a gold dip finish on atomizers we would say that the service of 4 to 6 months is fairly good. Atomizers are subject to handling, and also to corrosive action of perspiration as well as the liquids used in them. A light protective coating cannot be expected, therefore, to give good service.

A good lacquer coating over the gold is strongly recommended. For information on type of lacquer to use for this work get in touch with lacquer manufacturers many of whom advertise in the METAL INDUSTRY.

A more durable finish on this type of work would be to nickel plate, and then electrogold plate. Of course this would be a more expensive operation, but the actual amount of gold used can be held to a very low figure even with the use of current. The nickel would provide the resistance to tarnish and prevent the brass underneath from bleeding through.

The brownish tinge which now develops on the gold dipped work is due to the brass tarnishing through the porosity of the gold film.

—G. B. H. Jr.

Engine Finish on Stainless Steel

Q. We would like to know how to secure a better engine finish on the sample of stainless steel metal sent you under separate cover.

A. Examination of the sample suggests several possibilities for improving the finish. Probably the most important of these would be to produce a better surface on the steel preparatory to spotting by polishing with a 120 set-up wheel, followed by a 150-wheel, a 180-wheel, then a 200 grease wheel. It might be possible to eliminate a step or two by trying one of the greaseless compositions after the 150 wheel in place of the 180 and 200 wheels.

A composition for the spotting lap

that has more cut than the one now in use is indicated. No. 0 oilstone powder mixed with olive oil to a heavy paste has been successfully used for this type of work. It should be spread on the work with a stiff sash brush in the manner of stippling before spotting.

If a felt lap is in use, it should be of the hardest grade of felt and should be heated well over a gas flame to increase the hardness and burn off the fuzz and ragged edges. A slight cupping of the lap will help to eliminate the deep cuts near the center of the spot.

From the appearance of the spot under a microscope, it is believed that a much higher lap speed would be desirable with sufficient lubricant to avoid burning. As a general rule, the finer the cut, the higher the speed.

A smaller spot could be produced much more uniformly than the size on sample. Where spots about 3/8" or less in diameter can be used, a wool lap generally gives best results. Basswood, larch or other fine grain wood is most suitable.—L. A. C.

Lumps in Silver Plating

Q. We have a problem, or rather a condition, that appears each year during the warm weather. Small lumps (size of pencil point) are deposited on the surface of the work, particularly on the concave or indented surface of trays and bowls; sometimes on the convex or outside surface, but not so frequently. I have found from experience that the addition of an excess amount of cyanide to the solution helps to eradicate this condition to some extent, but not entirely. Of course, the addition of cyanide coarsens the deposit of silver and I wish to get away from this as much as possible. The condition occurs later in the day when it is hot (not early in the morning) when unloading part of the tank and the rheostats are changed so as not to burn the remaining work. It seems the change in the density of the current from high to low aggravates this condition. Could the deposition of the lumps of metal be caused by an excess of carbonate, found in the tank, from the hot weather? Would the excess carbonate cause an external variable resistance to be built up in the solution?

A. The lumps appearing on the work during plating are due to the presence of solid particles in the plating solution which migrate to and are eventually deposited upon the cathode. This is confirmed by the most frequent location of this defect and by the fact that it occurs mostly after the solution has been stirred during unloading (the stirring being the factor and not the decrease in current). The obvious remedy for immediate relief is to filter the solution.

To prevent recurrence of the above, the possible sources of the solid particles in the solution must be considered. The fact that they occur only in the summer, points to at least two possibilities. First of all, and the less likely of the two, is contamination of the plating solution by the water entering either for replacement of evaporation losses, as drag-in, or both. Water in the summer is apt to be much dirtier than otherwise for a variety of reasons. The second possibility results from the more rapid destruction of the cyanide in summer and the excessive formation of carbonates. Both of these factors interfere with proper anode corrosion and lower the permissible anode current density, especially if the solution is comprised of sodium rather than potassium salts. The net result, unless deliberate precautions are taken, is increased anode sludge which eventually causes rough deposits at the cathode. Increasing the free cyanide content not only improves conditions at the anode but may actually dissolve some of the particles and sludge in the solution, giving improved plate.

There are, of course, other important considerations not correlated, at least directly, with the seasons. Noteworthy is the purity of the anodes used, which should run 999+ fine. Extremely small amounts of certain impurities may result in rough deposits.

Specifically it is recommended that the solution be carefully filtered, that the free cyanide content be maintained at a higher value (½ to 1 oz./gal. more) than usual, that the anode surface be increased so that it approaches the cathode area as closely as possible and preferably exceeds it, and that the condition of the water be investigated and perhaps filter cloth tied over the faucets. If the bath is operated properly, the above increase in cyanide should not result in inferior plate. Bagging the anodes is also advisable.

—Research Electrochemist.

Chrome Plating Nameplates

Q. We are having difficulty with nickel peeling during chromium plating. Can you also tell me how to chromium plate a doctor's nameplate and if the background can be a white chromium? With the pieces I have tried, the outside rim will plate satisfactorily but the letters and background are not covered completely with chromium.

A. The analysis of your solution is:

Nickel	3.5 oz./gal.
Chloride, as amm. chloride	1.9 "
pH	5.7

Increase the chloride content by adding 1 oz./gal. of ammonium chloride. Otherwise, as far as the above constituents are concerned, your solution is all right.

Peeling may be due to not thoroughly rinsing after cyanide copper plating. Check on the cleaners. Make up a new one if the old one has been in use for a long time. Same for acid dips.

In chromium plating the background of signs such as you describe, it must be realized that the background is a rough surface and therefore has a large area. Your difficulty in getting this to cover with chromium is probably due to not having high enough current density. In order to obtain sufficient current in the background, you will have too much current for the edges and these will therefore have to be protected with thief wires.

Before going into this, however, I suggest you have the composition of the solution checked. Also clean the anodes and connections so you are certain of obtaining the best possible current conditions.

A decorative finish can be had on the type of sign you mention by plating the sign with a fairly heavy chrome, about 15 minutes. Paint portion of sign desired to remain chrome finish (such as the letters and edges) using an asphalt paint or stop-off lacquer. Then immerse in hydrochloric acid and dissolve chromium from background. The background can then be oxidized. Lacquer. You will then have a sign with a black background, and chromium plated letters and edges.—G. B. H., Jr.

ELECTROPLATING DIGEST

SELECTED ABSTRACTS ON PLATING—FINISHING—RUST PROOFING—LACQUERING

A Resume of Iron Plating

Joseph B. Kushner, Ch.E.

Iron, the second most abundant of all the metals, the metal that is most frequently employed in construction and fabrication, is paradoxically, the least useful in electrodeposition. Its physical characteristics and those of its common alloy, steel, are so widely known they need not be described here. Suffice it to say that the whole of our modern civilization depends to a large degree on its remarkable properties. Yet strange as it may seem, iron, in spite of its low cost and prevalence, is rarely employed by the plater.

The reason for this is not hard to find. Iron is a metal that cannot be plated for either decorative or protective effects. Its position in the electromotive series is fairly high, which makes it prone to corrosion; a fact evidenced by the millions of dollars spent annually in the protection of the metal against its enemy—rust. The appearance of iron plating is not pleasing. In a very pure state iron is silvery white in luster but in the ordinary form and upon standing, it soon takes on a dark greyish cast. Thus any use iron deposition may have is confined to the fields of electrorefining, the building up of worn or improperly machined iron and steel parts and the electroforming of objects such as printing plates and boiler tubes.

For certain purposes it might be feasible to deposit iron then case harden it, but in many applications of this type, nickel and chromium are plated instead as they give the requisite hardness without possessing the susceptibility to corrosion. However, it is possible in cases where operation on a large scale is to be performed, that the low cost of the metal and the fact that high current densities can be employed, will permit the successful use of iron.

Iron is a member of the nickel-cobalt series of elements and possesses many of the group properties besides a few characteristic failings of its own. It tends to oxidize from the ferrous form (valance 2) to the ferric form (valance 3) and the ferric form in neutral or nearly neutral solutions tends to hydrolyze thus:

$$Fe^{+++} + 3(OH)^- = \underset{\text{ppt.}}{Fe(OH)_3\downarrow}$$

As a result of this, many iron plating baths form a scum or film of oxidized metal and basic compounds on the surface upon standing; others develop finely divided suspensions of basic iron salts of extremely variable composition after a period of use. These reactions are especially likely to occur in solutions of pH in the vicinity of 7, causing the cathode efficiency and other plating characteristics, to become rather erratic, a difficulty which can only be overcome by careful control of acidity and regulation of electrode dimensions. In passing, it may be noted that nickel possesses this same tendency but to a much less degree as it is relatively more noble than iron (iron,—0.44; nickel,—0.23 single potentials referred to hydrogen electrode). Another fault of some of the suggested plating baths for iron is that deposits are formed which tend to be black around the edges or else are pitted, pin-holed and cracked, or are spongy and contain excessive oxide inclusions. This failure to obtain smooth, fine grained, metallic deposits can no doubt be traced to the previously mentioned susceptibility of iron to oxidation in solutions near the neutral point.

The first recorded data on the electrodeposition of iron were reported by A. C. Becquerel[1], in 1831, when he noticed that small granules of iron were plated out on a platinum cathode on the passage of an electric current through concentrated solutions of ferrous sulphate or chloride. This phenomenon was also recorded by Boettger[2], in 1846, and in the same year, Buschmann and Liet[3] prepared plates of iron two millimeters in thickness. This evidence seems to contradict the remarks of some popular writers on the subject of electrodeposition who state that the plating of iron began in 1860[4].

Watt,[5] in a really fundamental research, tested the properties of over 40 different iron compounds as plating electrolytes. He used ferrous and ferric salts; both organic and inorganic and though he was able to obtain fair deposits from several of them, came to the conclusion that for practical plating purposes the best types of baths were:

1. The ferrous ammonium sulphate bath.
2. The ferrous magnesium sulphate bath.
3. The ferrous sulphate-ammonium chloride bath.
4. Ferrous sulphate by itself.

Watt also claimed that if any reducing compounds were to be added to the baths to prevent oxidation, the best seemed to be either small doses of citric or tartaric acids, which seemed to improve the brightness of the deposits.

Hughes[6], in a summary of research on iron plating since 1860, including his own work, came to the conclusion that:

1. The best electrolytes are: (A) Those containing ferrous sulphate, (B) Those containing ferrous chloride, (C) Those containing a mixture of the two.
2. Ferrous salts are the only useful ones.
3. It is unnecessary to employ addition agents such as gums, gelatin, etc.
4. Opinions differ as to whether the solutions should be neutral or acid.
5. The object for which the deposit is required must be taken into consideration in deciding what type of bath to use.

Experiment and experience through the years have shown that there are really only three practical types of iron plating baths. These are given here:

1. *The Ammonium Ferrous Sulphate Bath*

This bath is one that was recommended by Macfayden[7] in 1920 and is one that saw frequent service during the war.

Ferrous ammonium sulphate	47 oz./gallon
Sulphuric acid	0.03 "

Room temperature. Current density, 19 amps. per sq. ft. Use anodes of iron, graphite or low carbon steel.

2. *The Ferrous Chloride-Calcium Chloride Bath*

This bath, called the Fischer-Langbein[8] solution was originally patented by them in 1908. As given by Blum and Hogaboom[9] the formula is:

Ferrous chloride	40 oz./gallon
Calcium chloride	45 "

Temperature, about 194°F. Permissible current density 186 amperes per sq. ft.

The purpose of the calcium chloride as stated by the patentees is to reduce loss of liquid by evaporation, by raising the boiling point of the solution. Of course, in addition to this, the calcium salt increases the conductivity and depresses the ion concentration because of the common ion effect.

2A. *Modified Ferrous Chloride-Calcium Chloride Bath*

A bath of the composition given in (2) plus the addition of sufficient hydrochloric acid to bring the concentration up to 0.01 or 0.02 normal (approximately 0.16 to 0.32 oz. of concentrated acid per gallon) was recommended by Thomas and Blum[10] in a paper to the Electrochemical Society. They found that such a bath gave excellent heavy deposits of iron that could be satisfactorily used for printing plates. The temperature employed by them was about the same as given previously though the current density used was somewhat lower (60 amperes per sq. ft.) The anodes were rolled Armco iron contained in porous alundum pots. Moving cathode agitation was employed and smooth, dense, adherent, heavy deposits of

(*Continued on page* 395)

METALLURGICAL DIGEST

SELECTED ABSTRACTS ON CASTING—ROLLING—PHYSICAL METALLURGY

Etching Aluminum

According to British patent 496,613 assigned to Aluminum Colors, Inc., an aluminum surface containing less than 0.05% copper can be etched to produce a reflecting surface, free from streaks, by treating the aluminum in a hot solution of an alkali e.g. caustic soda, in which is dissolved a compound of copper, lead or cobalt. The etching is continued at 140°-170°F., or when a lead compound is used, at approximately 100°F. until a dark deposit is formed on the aluminum. The deposit is subsequently removed with a solvent such as dilute nitric acid, and the resulting surface is left clean and brightly etched, free from streaks. Substances capable of maintaining the copper or cobalt compound in solution may be added, such as ammonium hydroxide, glycerin or rochelle salts.

Metals in Foodstuffs

Metals in foodstuffs can be the cause of serious poisonings even when involving metals that are ordinarily considered non-poisonous. Copper in very small quantities can seriously affect milk, and iron, in somewhat greater quantities, can also affect milk, similar to copper. Stainless steel, aluminum and duralumin are not attacked by milk at room temperature. Metals produce a catalytic effect on the dissociation of fat. Tin coatings may be attacked by milk if small amounts of copper compounds are present.

On Lead Alloys

The physical metallurgical changes which occur in lead alloys at room temperature are interesting and of considerable practical value. Lead-antimony is a precipitation hardening alloy, the greatest hardness being obtained with from 0.5% to 3.0% antimony. Small additions of copper and arsenic of only a few hundreds of a percent improve precipitation hardening greatly. Lead-calcium alloys show the same hardening properties as lead-antimony alloys. The most favorable calcium content is 0.035%. Sodium and lithium will harden lead-calcium alloys. Lead-tin and lead-cadmium alloys show much less precipitation hardening. Tellurium lead alloys show delayed recrystallization after cold working as well as do the lead-calcium alloys.

On the Nature of Friction

When two small, clean unlubricated metal plates are slid by one another, the sliding motion may be found to be a series of jerks. The surfaces stick, move together for a brief period and suddenly slip. The friction is, therefore, due apparently to welding at the points of contact, because every time a slip occurs, there is a very sudden rise in temperature followed by a rapid fall. Deformations are also produced to a considerable depth below the surface and thus friction must involve more than just surface forces. The extent and nature of the slip depends upon the relative melting points of the two metals between which the slide occurs. When a metal of high melting point slides on one of low melting point, the slip is comparatively small and there is a ploughing of the soft metal. When the slider has a lower melting point than the surface, the slip is very much larger in extent, and the slip produced appears to weld the low melting metal to the other. When both surfaces are of the same metal, however, friction is higher and fluctuates considerably but with no sudden slips. Both surfaces appear to melt and weld quickly.

Etching of Stainless Steels

Aqua regia and hydrofluoric-nitric acid solutions are not entirely satisfactory etchants for distinguishing structures in stainless steels. However, anodic etching in 10% oxalic acid at 5 to 6 volts will be sufficient for the detection of carbides in from 15 to 30 seconds and for revealing the grain boundaries in from 30 to 40 seconds. The method is particularly good for high chromium austenitic steels. For austenitic, ferritic and martensitic steels containing less than 15% chromium, an etchant composed of 30 cc. concentrated HCl; 40 cc. water; 5 grams of cupric chloride crystals and 30 cc. of alcohol will clearly show grain boundaries of austenitic steel, together with twins, slip bands, and any carbides. It is used cold; etching time is about 30 seconds.

Polishing Transforms Surface of Stainless Steel

Electron diffraction studies of surfaces of steels containing 18% chromium, 9% nickel, and 0.08% carbon showed that even light polishing on 0000 emery paper, transformed a small layer beneath the surface 0.00001 centimeters in depth from the gamma to the alpha phase, thus this thin layer is 90% ferritic and, of course, below the surface is wholely austenitic.

New Uses Found for Gallium

Gallium, a metal melting at 85.6°F. is being used to fill thermometers especially quartz glass capilliary tube thermometers. The vapor pressure of gallium is practically negligible up to 1000°C. Gallium has been used for electric fuses, and due to its high boiling point (3760°F.), it is used as a liquid seal at elevated temperatures. Gallium has been used on optical mirrors for astronomical purposes, and its salts have been used in electron tubes. It may replace mercury amalgams in the dental field and a typical alloy is composed of gallium, tin and bismuth which is silver-white and melts at 112°C.

Lead Increases Machinability of Steel

The addition of very small quantities of lead to steel results in considerable improvement in machinability. As little as 0.1% is beneficial and the effect increases up to almost 0.5%. However, the limit of dispersion is slightly under 0.5%. The microscope fails to show lead present as a separate phase or particles when present in concentrations from 0.2% to 0.25%. However, X-ray diffraction shows it to be dispersed in the ferrite. Lead-bearing steels are not brittle and are hardly distinguishable from non-leaded stock in their physical properties, including aging and cold drawing. Increased machinability efficiency from 25% to 75% has resulted from the use of lead, and in one case, an SAE 1020 steel required 17 minutes for machining, whereas the lead-bearing SAE 1115 steel required only 5 minutes for machining.

Grain Growth in Silver

The addition of less than 0.5% of nickel to silver greatly reduces its tendency toward grain growth. The cold tenacity of the alloy is also increased about 10% and its hot strength about 20%. There is also a decrease in expansion of from 5% to 10% and the elastic limit of the silver is reduced without lowering its resistance to chemical attack.

Coating Non-Conductors with Silver

According to British patent 494,379, metallic silver can be deposited in a coherent coating upon glass and other non-metallic surfaces by means of mixing two jets of solutions: one jet containing a salt of the metal to be deposited, namely —ammoniacal silver, and the other solution a reducing agent containing for example, rochelle salts, formaldehyde or sugar. The reaction can be accelerated by blowing an additional jet of steam or heated gas into the atomized mixture.

Post Scripts

Heat and high humidity are here again. Wrinkled suits, soiled shirts, "blushing" of lacquers and staining of zinc and cadmium plating as well as orneriness with oxidized finishes. It only takes a trace of acid or alkaline fumes to make zinc or cadmium stain in hot humid weather but try to convince the boss!

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At Asbury Park

(Continued from July issue)

Tuesday, June 20th. This was the hardest day of the convention with three educational sessions. *Professor Burt-Gerrans* started the ball rolling with a scholarly discussion of diffusion in electroplating and about 11:30 in the evening, *L. A. Critchfield* concluded the sessions with a fascinating story on time pieces, with many ladies in attendance in the audience, which was treated to a Turkish bath due to the high temperature and humidity. *Arthur Hothersall* loyally listened to all of the papers at the sessions and later said that his three years in Burma prepared him for American weather.

George Westerberg, Oscar Servis and Joe Bykowski at Asbury Park.
(By Burt Daw, LaSalco, Inc.)

Late in the evening, *Bernard Case, Bob Wagner* and *Arthur Hothersall* were found embroiled in a discussion on X-ray diffraction of electrodeposits. I met *Dr. Ken Graham* and we promised to have a chat later. *Adolph Grele* and *Oscar Stocker* of Seymour Mfg. Co., invited me to their room to see their new bright nickel. *Meyer Freed* was the pro tem *maitre d'hotel.* Met *Fred Gumm* for the first time at the convention.

In the yawning about 3:00 A.M., I joined a party consisting of *Mr. & Mrs. Clarence Helmle, Mr. & Mrs. William Erskine, Mr. & Mrs. John Charleson* and *Mr. & Mrs. Jack Buckman* to see the night life of Asbury Park which consisted of two hot dog stands, a miniature golf course, and a dime a dance joint with a slap-happy orchestra.

We decided to be sensible and go to bed at 3:30 A.M. thinking we were the only ones still up when we met all of Newark led by *Horace Smith* who has gone back to wearing a belt. *Ed. Berry* so startled Horace by ordering milk that Ed had to repeat his order again to convince Horace.

Wesley Cassell wandered on to the balcony of the hotel leading to the boardwalk about this time and met a fellow A.E.S. member. To Cass's kind query of "What'll you have?", came a dismal rejoinder—"I want ice!"

Wednesday, June 21. At 6:15 A.M. our 4-year old daughter, Joan, decides she wants to go swimming. No, she doesn't care whether Daddy is tired and had only two hour's sleep. After stalling her until 7:00, we call the Sports Director who sleepily states that "the pools aren't filled until July." We met *Bill Bridgett* looking chipper at breakfast (7:15).

The day was brilliant and clear in contrast to previous rain and heat. The visit to Anaconda, H-VW-M Co., and the lunch at Buttonwood Manor went off smoothly. The only excitement which came to our attention was furnished by an Indian from Springfield, Mass., who tried to set fire to the bus. Had a chat with *Joseph Petrocelli* of Waterbury who has mapped out an ambitious program for next year. In addition to his work at Patent Button Company, Joe plans to study for his Ph.D. at Yale in the Dept. of Metallurgy and in addition hopes to get married in the spring.

We looked over the exhibit of plated ware with much care. The electroplated reflectors of *Bart Laboratories* and *Tom Slattery's* exhibit on iron plating were particularly unique and interesting. We looked in vain for the electroplated pig which *George Hogaboom* had promised, but *L. A. Delamonte* of Oakland, Calif., had some plated roses and grapes.

Congratulations to the New Haven branch for the splendid, prize-winning exhibits and to *George Knecht,* official "rounder-upper."

In the afternoon, the brilliant sun lured many of the conventionites to attempt to bathe in the surf of the Atlantic Ocean.

"Bill" Davidson of Detroit Rex—just waiting for a nibble.
(By John J. Landy, DuPont Co.)

Drs. C. B. F. Young and *Junius Edwards* seemed to enjoyed the water as well as *Clayton Hoff* and *Richard Hull* of the duPont Company. *Sylvester Gartland* almost lost a pair of shoes in the waves, not realizing that there is considerable change in the water level due to the tides in the ocean.

Robert Jackson, Jr., of Star Metal Company, Philadelphia, enjoyed *Wilfred S. McKeon's* company so well at dinner-time that he slept through the entire meal—or was it something Bob ate that was responsible for his apparent ossification.

Group photographs were taken at noon. *Jack Geissman* was unable to be present as it was reported he lost his pants in a poker game. He tried to watch the proceedings from his room window but complained that *Frank Hanlon's* sunburned head so dazzled him that he could not watch the proceedings.

Three lady registrants waiting for their husbands at Asbury Park. Left to right—Mrs. S. E. Hedden, Mrs. Leo C. Jones and Mrs. Eva Bergemann.

Bill Scott of Cleveland wore a disguise of a two-days' beard but nevertheless his identity was discovered.

We learned that *Rudy Hazucha* is one

of Chicago's leading bowlers, bowling in the Randolph League and being able to maintain a big pin average of 195.

(*Concluded in September*)

•

"There isn't a decent shop in this place. I have been into every one and couldn't get what I wanted."

"Well, what did you want?"

"Credit."

•

All Roads Lead to Sandy Mac's

The *Detroit Branch* of the A.E.S. will hold its annual picnic and Summer Get-to-Gether on Saturday, August 5th, at Sandy Mac's Golf Course. The all day outing will include golf in the morning, noon day lunch with the usual special dish of sweet corn, and events for prizes in the afternoon. Of course, there will be the usual race to see whether the gang can drink up more beer than the Committee ordered, or whether the Committee will have more free beer on hand than those present can drink. However, the Committee never wins.

As the golf pitching contest was won with a driver last year, all drivers are barred this year.

The Committee is now looking for several honest, upright, and steadfast men to act as umpires in the baseball game. Another requirement is that the umpires for the ball game be fast runners and good dodgers.

Members of other branches are cordially invited to attend this outing, and renew friendships with members of the Detroit Branch.

•

Frank Hanlon and *H. A. Gilbertson* gave an interesting and complete account of the A.E.S. convention at Asbury to the Chicago branch. We heartily agree to Chicago's suggestion that papers should be pre-printed and mailed in advance to all the members.

•

Fred Fulforth contributed the following true story: Boss Polisher to Boss Plater, "Why do we always have trouble buffing in the morning but in the afternoon everything is good." Boss Plater—"Well, you see the first load in the morning is never good because etc." Boss Polisher—"All right, then don't plate the first load—start with the second."

•

Paul Strausser wrote that he has recovered from his operation and is back at work.

•

Jack Tierney says he conceived the idea of his new spray rinser from the geyser which he depicts spouting. Actually, I think he conceived his "scotch mist" machine when he was a boy watching the elephants spray themselves when he worked his way into the "Big Top."

•

Bits from the Mail Bag

George Simmons takes ye Editor to task for seemingly confusing the progeny of the proud papas of Binghamton—his letter follows:

Dear Dr. Meyer:

The "offspring fever and stork craziness" of Bob Burns has been far outclassed by *Austin Fletcher* of our branch, according to the reports of Dr. Meyer in the Post Scripts of June and July.

The family standing of Pac in Vicki Baum's "Tale of Bali," also assumes relative simplicity.

As secretary of the very respectable Binghamton-Syracuse Branch, I feel it my duty to straighten out the extremely confused family of our Librarian. Austin has one (1) wife and two (2) daughters (girls), one of these daughters (girls) being about 5 years of age and the new daughter (girl) being about 3 months. Also, the 2 (two) boys of Larry Meyer mentioned in the July issue, happens to be 3 (three) boys.

It is hoped that the editor of Post Scripts will in the future, rely on a very positive source of information when writing up any additions to our Branch membership.

It would be regrettable to have some of our wives get the wrong impression—(dual lives, etc.)

Yours very truly,
George Simmons, Secy.

Thanks, George—I will have to discard my memory for a notebook in the future. I wouldn't want to give the wives any wrong impressions.

Louis Lougee, Warren Jaquiery, and Joe McConas tagged for any eventuality at Leacrest.

•

Willoughby "Bill" Sheane, G.E. finishing expert has gone and done it. About a month ago he changed the name of *Miss Genevieve Buchhold* to *Mrs. Willoughby Sheane.*

•

Those tickets hanging on *Joe McConas, Louis Lougee* and *Warren Jaquiery* remind me of a true story which *Bob Leather* tells about a certain chap from Elmwood whom we, to preserve anonymity, shall call *Mr. Behind Eightball.* The card states "When I'm plastered, take me home, Ring the Bell, Run like H—." This card served Mr. Eightball in good stead as after becoming steeped in grape juice, and losing his powers of locomotion, his boss delivered the *corpus delicti* to Mrs. Eightball in Elmwood and demanded her signature on the ticket as a receipt. The following letters explain the happy denouement and, of course, fictitious names are used except for Bob's.

Winken-Blinken-Knodd Company
May 15, 1939.

Lea Mfg. Co.,
Waterbury, Conn.
Dear Mr. Leather:

I am enclosing bill of lading covering receipt of delivery of one Mr. Behind Eightball, from Leacrest Farms, Bethlehem, Conn., to Elmwood, Conn. There will be no charge for this service and I am glad to report the merchandise arrived in reasonably satisfactory condition.

Again may I express my appreciation for your kind invitation to your party at Leacrest. I enjoyed every minute of it and hope to see you soon.

Very truly yours,
Winken-Blinken-Knodd Company
G. Samaritan
Territorial Manager—Industrial Sales.

May 16, 1939.

Mr. G. Samaritan,
Winken-Blinken-Knodd Co.,
Jersey City, N. J.
Dear Mr. Samaritan:

Thank you for the bill of lading, and let me compliment you on your excellent service. There were a lot of other deliveries that should have been made last Saturday, but unfortunately we have a very poor transportation condition in the little town of Bethlehem. So far there have been no claims for lost husbands, but I do anticipate a few claims for goods received in disorderly condition.

We certainly appreciated having you come up all the way from New Jersey to attend our party, and sincerely hope that we will see you quite often at our numerous gatherings.

Sincerely yours,
R. S. Leather

•

Congratulations are in order to: *Miss Frances Suarez* of Philadelphia Quartz Co. for receiving the honorable mention from the Josephine Snapp National Competition for advertising women, and for her contributions to the new book "Advertising Careers for Women."

To *Richard O. Hull* (DuPont Co., Cleveland, Ohio) for presenting two top-notch papers at Asbury Park, both of which are of medal winning quality.

To *Dr. W. A. Wesley* (International Nickel Co.), *Walter C. Pinner* and *L. E. Borchert*, and *Derick S. Hartshorn, Jr.* (Westinghouse) for their well merited awards.

To *Edward Magnuson* for his fascinating biography entitled, "The Skipper's Own Story."

Pleasant Vacations
By the Way
Send Us a Post Card

Walter R. Meyer

NOW READY FOR YOUR USE

The Utility You Have Been Waiting For
The Economy You Have Hoped For
All You Might Ask For In
Manually Operated

SPRAY RINSE TANKS

(THE STORTS "RAPID-CLEAN" SPRAY RINSE TANK)

For better - quicker - cleaner rinsing, with less water and for saving time - space and money, is yours for the asking - NOW!

PATENTS APPLIED FOR AND PENDING

NEW --- NOVEL AND PRACTICAL --- IN TWO TYPES "FOOT PEDAL" AND "HAND LEVER" OPERATED

■

Dr. Walter R. Meyer — after observing a pre-announcement demonstration of the mechanical and production utility features stated — "Its development is a definite forward step toward making plating-room rinsing procedure more sensible and less costly."

ONE PROOF OF THE "MORE SENSIBLE AND LESS COSTLY" SPRAY WAY

At Providence, R. I. (low water pressure area) . . . Manufacturer operating three 8 hour shifts per day. . . Rinsing 1,440 racks of work (1 per minute) in "still" rinse tank. . . Physical test showed 11,664 gallons of water (8.1 gallons per rack) overflowing in 24 hours. . . Storts "Rapid-Clean" Spray Rinse Tank does a better - quicker - cleaner rinsing job and uses only 1,512 gallons (1.05 gallons per rack). . . Water savings 10,132 gallons in 24 hours.

FULL PARTICULARS DESCRIBED IN OUR BOOKLET — "RINSING WITH SPRAY — THE STORTS WAY" — IT'S YOURS FOR THE ASKING — WRITE FOR IT NOW

STORTS WELDING COMPANY

42 STONE STREET MERIDEN, CONNECTICUT

Manufacturers of High Quality Welded Fabrications to Specification

THE STORTS WAY — OF USING SPRAY — IS AS NEW — AS NATURE'S WAY — IS AGES OLD

NEW EQUIPMENT AND SUPPLIES

NEW PROCESSES, MATERIALS AND EQUIPMENT FOR THE METAL INDUSTRY

Safety Type Carboy Pourer

Lewis-Shepard Sales Corporation, 245 Walnut Street, Watertown, Massachusetts, announce the development of a new type of safety Carboy Pourer. Light in weight and rigidly built, it may easily be handled by one man, quickly and safely.

Developed in cooperation with the Aluminum Co. of America to handle the new all-aluminum carboys, Lewis-Shepard offers this new safety device in addition to their line of pourers for use with standard glass carboys in wooden cases.

Operation of the new Carboy Pourer is very simple. With the carboy resting on its base, the pourer is placed over the top and clamped securely by means of a threaded handle just below the shoulder. Then an easy pull on the handle brings the carboy over into pouring position, resting on a broad rocker base. Pulling the carboy pourer still further until it rests upon the handle, permits complete drainage of carboy. The accompanying photo illustrates carboy in pouring position with the cap removed.

Papers for Filter Presses

One of the difficulties encountered in filtering operations, especially electroplating solutions, is the clogging of the filter. Canvas filter cloths are used over the plates and frames of the filter press in most cases, but even when a filter aid is used, the cloths pack with solid matter and in this condition they are very difficult to clean.

The Hanson-Van Winkle-Munning Co., Matawan, N. J., manufacturers of electroplating equipment and supplies, have recently placed on the market a newly developed filter press paper which is said to offer a solution to this problem. At present the papers are furnished in reams of 500 sheets, in 12½″ x 12½″ squares, to fit a 12″ x 12″ press. Two holes are machine-cut in opposite corners of the paper to line up with holes in the plates and frames. Other sizes can be furnished, however, with holes cut to suit the existing press equipment.

To use these papers, they are placed over the cloths when assembling the press, making certain that the flow of solution is through the paper toward the cloth. The paper thus catches all the suspended matter being filtered from the solution—the cloth simply acts as a support for the paper. When it is necessary to clean the press it is opened and the papers with the collected sludge removed and discarded. It is seldom necessary to remove the cloths from the press as the paper does over 99% of the work.

This paper is unique in that it has nearly as high a wet breaking strength as the dry breaking strength. This characteristic is not found in ordinary filter papers. As the paper is only 0.003″ thick it does not hold the plates away from the frames in the press. Good contact is maintained and the solution does not leak from the press.

Electric Immersion Heaters for Electroplating Baths

A line of heating units designed for immersion in all kinds of electroplating baths is offered by the General Electric Company. These heating units are made with steel or lead sheaths or are cast in lead so that heaters are available for practically any type of service.

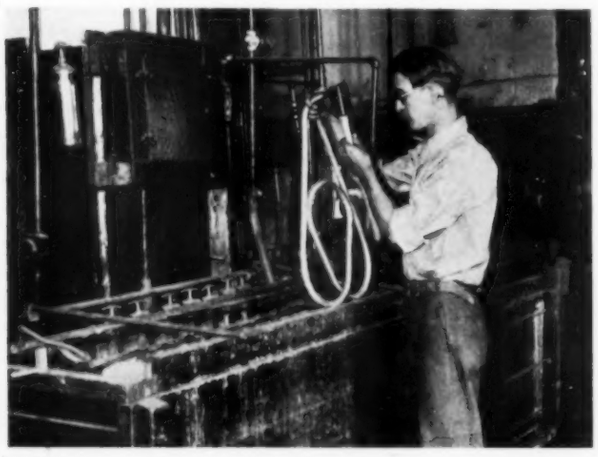
Warm solutions are commonly used for the following reasons:

1. The increased solubility of the salts permits higher concentration and consequently higher current densities without seriously reducing the metal content of the solution near the cathode.

2. The increased conductivity reduces the tendency to "treeing," or building up of deposits in spots, and also produces high current densities at a given voltage, which tend to reduce crystal size.

3. The occlusion of hydrogen is decreased. Hydrogen occlusion is one of the common causes of cracked deposits, especially in nickel plating.

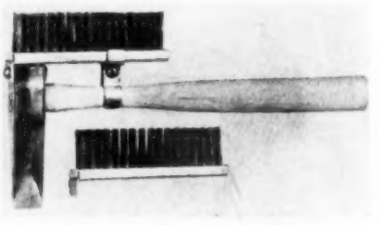
These electric immersion units are easy to apply over the side of the plating tank, and can easily be removed when heat is no longer needed. Complete information about the use and application of these heaters is given in the General Electric publication "How to Heat Electroplating Baths with G-E Immersion Heaters" (GEA-3195).



Examining an immersion heater.

Combination Chipping Hammer and Wire Brush for Welders

A new convenience tool for welding departments is the Triplex Welders' Chipper, manufactured by St. Pierre Chain Corporation, Worcester, Mass. It consists of a drop



forged steel chipping hammer with hardwood handle, having a heavy duty wire brush rigidly mounted on the top side. The hammer chisel chips and breaks the scale, then the tool is turned in the hand and the brush is used to clean the surface. The wire brush is held in place by stout bolts which can be loosened to reverse the brush and thus get full wear from it, or to remove it and insert a new brush. The chipper was designed especially for the quick and thorough removal of slags formed on top of weld metal when heavily coated electrodes are used, but it is equally useful for removing rust and scale to provide a clean bright surface for welding. The tool is being sold through welding supply dealers.

Cast an eye upon these

SMALL PERCENTAGES

1½% High-speed, precision worm gears withstand extreme pressure and temperature when cast in 1½% Nickel bronze, says Baush Machine Tool Co., Springfield, Mass. Chilled at periphery, Nickel bronze provides increased hardness where stress and wear is greatest. For strength and toughness in bronze castings subject to unusually high stresses, use Nickel.

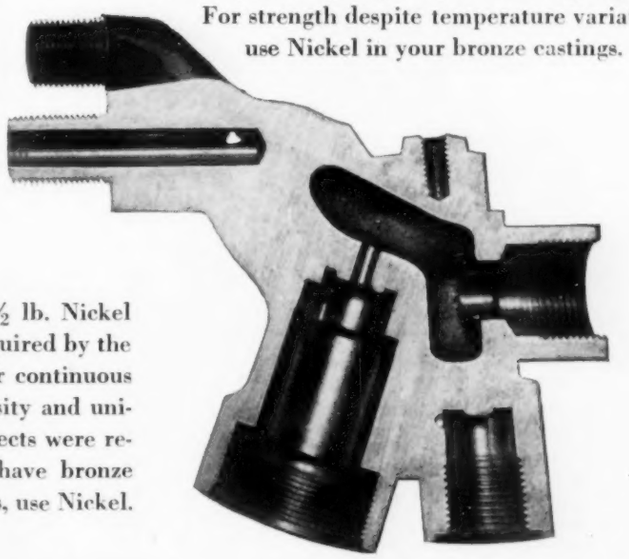
. . . a little

CAST NICKEL BRONZE

helps a lot

1½% G-E oil-cooled transformer parts must stay oil tight hence all bronze castings used (example pictured above) are given a hydrostatic pressure test. For these castings the General Electric foundry at Pittsfield, Mass., add 1½% Nickel to their regular 85-5-5-5 mixture. In one run of 120 castings every part was oil tight after machining. For uniform structure and continued pressure tightness in bronze castings, use Nickel.

1% Locomotive boiler feed pumps must withstand shock, wear and pressure at varying temperatures. These 1% Nickel bronze feed pumps (left) were cast by Textile Machine Co., Reading, Pa., for J. S. Coffin Jr. Co., Englewood, N. J. Tested to 400 p.s.i., "proved satisfactory in every way", says consulting engineer. For strength despite temperature variations, use Nickel in your bronze castings.



1% Seven twisting water passages in a 2½ lb. Nickel bronze casting (right). That was the job required by the Ritter Dental Mfg. Co., Rochester, for their continuous flushing cuspidor. By using 1% Nickel density and uniformity were so improved that foundry rejects were reduced, machining costs lowered. Do you have bronze problems? For uniformity in bronze castings, use Nickel.

THE INTERNATIONAL NICKEL COMPANY, INC., 67 WALL ST., NEW YORK, N. Y.

The Rectoplater

By H. R. MALLORY

Rectifier Sales Division,
P. R. Mallory & Co. Inc.,
Indianapolis, Ind.

"Rectoplater" is the trade name of a new type of power supply as manufactured by the P. R. Mallory & Co., Inc., for all types of electrolytic processes.

Instead of the customary motor generator set, in which power from the line is converted into mechanical energy and then back again into electrical energy of different characteristics, a Rectoplater is a static device converting the alternating current of the power line directly to direct current by means of a step-down transformer, a rectifier and a properly designed cooling system. The moving parts in a Rectoplater, therefore, are limited to a small cooling fan and motor. As a result of this absence of large moving

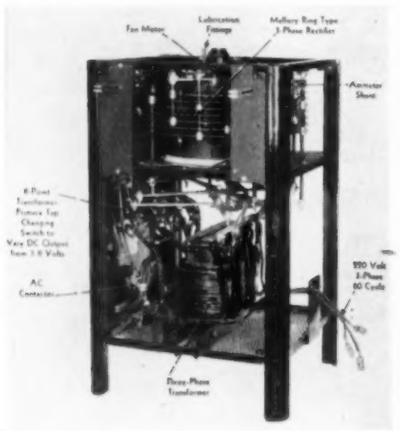

Fan Motor
Lubrication Fittings
Mallory Ring Type 3-Phase Rectifier
Ammeter Shunt
6-Point Transformer Primary Tap Changing Switch to Vary DC Output from 3.8 Volts
AC Contactor
220 Volt 3-Phase 60 Cycle
Three-Phase Transformer

Fig. 1. Interior view of 500 ampere 7½ volt Rectoplater.

parts and masses, maintenance is reduced to a minimum (in some models no lubrication is necessary because of sealed bearings) and no heavy starting current surges are encountered, the starting current being the same as the running current.

The design of a Rectoplater is much more flexible than that of a motor generator in that the various parts are not mechanically interconnected and may be located in such a way as to occupy the minimum amount of floor space and take the best advantage of the forced cooling air. In the usual design, as shown in Figure No. 1, the rectifier is mounted directly over the transformer, the cooling air being first drawn in and over the transformer, thereby decreasing its size, weight and cost, the air then exhausting through the rectifier. A design of this type also permits the use of a housing enclosed on all sides, thereby presenting a neat, modern appearance. Figure No. 2 shows the streamline outward appearance of the same 7.5 volt, 500 ampere Rectoplater shown in Figure No. 1. This type of housing also restricts the accumulation of dust and graphite in the machine and lends itself to the inclusion, in one of the panels, of all control equipment. The fact that the operating parts are not readily accessible, because of being enclosed in a housing of this type, presents unnecessary tinkering and adjustment.

The heart of the Rectoplater, of course, is the rectifier. After an extensive investigation of all types of rectifiers, the Magnesium-Copper Sulphide Dry Disc type of rectifier was finally selected because of its ability to rectify the heavy currents required for electroplating with the minimum amount of material and parts and with a ruggedness to withstand bad atmospheric conditions and an ability to withstand overloads and abuse. By way of example, a rectifying junction with only 1¾ square inches of area is capable of safely rectifying 100 amperes DC when connected in a three-phase, full-wave circuit. This is a current density of 57 amperes DC per square inch of active rectifying area, or approximately 50-100 times greater than the safe current density used by any other type of dry disc rectifier.

The Magnesium-Copper Sulphide rectifier was developed and patented more than ten years ago by Samuel Ruben. Since that time, uses have steadily increased until today rectifiers of this type are being used in such diversified applications as: air conditioned railway car battery chargers, motion picture arc power supplies, industrial and mobile truck battery chargers, automobile battery chargers, radio receivers, coin machines, etc.

In the electroplating field, Copper Sulphide rectifiers have been successfully used for several years. The present line of Rectoplaters has been announced only after conclusive tests over a period of two years have proven the superiority of the Copper Sulphide rectifier for this application. The ordinary type of Copper Sulphide rectifier, of course, was not practical for heavy currents required by electroplating. After many experiments into different methods of arranging the rectifying elements, the so-called Ring Type rectifier was adopted (patent pending) because this particular design provided the most efficient and uniform cooling, as well as voltage and current distribution from one rectifier junction to the next. Figure No. 3 shows in detail the construction of a Ring Type rectifier as used in all Rectoplaters above 300 amperes. It will be noted that

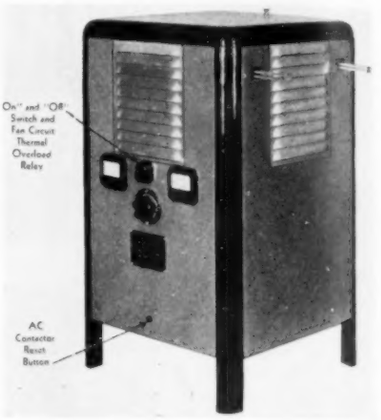


Fig. 2. External view of Rectoplater shown in Fig. 1.

the rectifying elements, or junctions, are clamped together by an assembly stud, the cooling fins being common to all paralleled junctions. The assemblage of these junctions in a circle provide absolute uniformity of cooling. Both the AC and DC connections to the rectifier are worked out in such a way that the resistance paths of the numerous connecting links are uniform. It is a well known fact that expedients of this type are essential in low voltage equipment where the life and performance of the product depends upon equal distribution between the various paralleled elements.

Control of the DC output of Rectoplaters is by means of a multi-point switch selecting different transformer primary taps. Maxi-

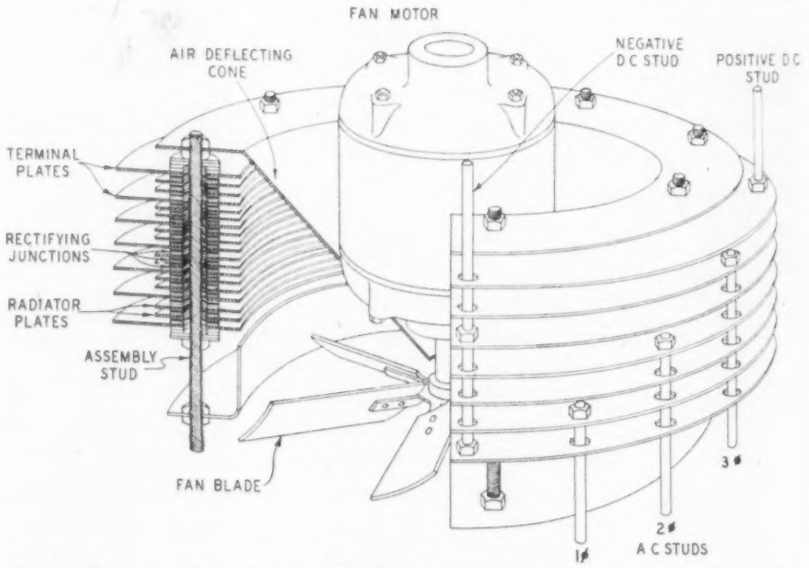


Fig. 3. Cutaway view of Mallory DC Power Dome and ring type rectifier as used in Rectoplater.

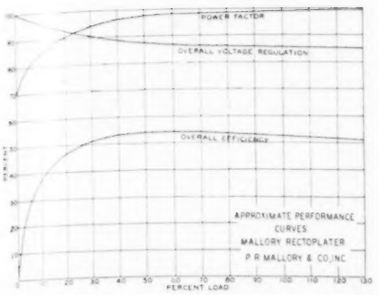


Fig. 4. Approximate performance curves of Rectoplater.

mum over-all efficiency is obtained by this primary switch control in preference to the more simple, but wasteful, DC series resistor. A switch has been designed in which the DC power supplied to the plating bath does not fall to zero as the switch is revolved from one position to the next, a necessary requirement in certain types of plating. DC voltage adjustments from ½ to full voltage are accomplished in 8-10 steps.

A rectifier power supply does not lend itself readily to compounding as does a motor generator. By proper design of the transformer and rectifier, however, the output voltage of Rectoplaters is reasonably constant from no load to full load. Without changing the output voltage adjustments, the DC voltage at full load is approximately 85% of the DC voltage at no load, as is shown in Figure No. 4.

Because Rectoplaters are an assemblage of rectifying elements, or junctions, all of which are operated under conditions approaching optimum, and because of the absence of large moving masses, the efficiency of Rectoplaters remains practically constant at 50-55% over the complete range of different size Rectoplaters and in any machine over the useful operating range.

Transformers used in Rectoplaters are of the two-winding, close-coupled type with good output regulation. The power factor of Rectoplaters, therefore, is very good, approaching unity over most of the useful operating range.

A curve showing the approximate performance of Rectoplaters is shown in Figure No. 4. As explained above, this curve is representative of the performance of any and all sizes of Rectoplaters.

In taking the best advantage of the characteristics of the rectifying elements, it so happens that Rectoplaters become available in multiples of 100 amperes and in voltage steps of 2.5 volts.

Because of the efficient use of the cooling air to reduce the size and weight of the transformer and because of the general simplicity of Rectoplaters, the total weight of a Rectoplater will be approximately ½-¼ the weight of an equivalent motor generator set of the same capacity. This advantage is very important when locating power supplies where floor loads are limited.

Figure No. 5 shows the installation of a 3000 ampere 7.5 volt Rectoplater in one of the largest electrotype plants in the world. The total output of the Rectoplater is used in the 2 series connected tanks in the foreground. Graphitizing tables are located within a few feet of the Rectoplater, thereby normally subjecting it to the most severe conditions. Again, by intelligent design and by the use of a fresh air inlet duct, which can be seen rising from the back of the Rectoplater, through which fresh air is drawn from the outside, no maintenance or blowing out is necessary. This Rectoplater has been in operation approximately 7 months and a close inspection of the interior disclosed a surprisingly small deposit of dirt and graphite and then only in the corners of the machine. It is customary in this plant to blow graphite and dust out of motor generator sets, located near the Rectoplater, at least once every week.

The quality of electrotypes, as made by the Rectoplater in this particular installation, is identical in every respect with that produced by motor generator sets. The permissible current density, plating time, etc. have been found to be identical to motor generator performance.

The conclusion reached by the operators in this plant, after 7 months of comparative tests and observations on the performance of this Rectoplater vs. a 6000 ampere motor generator set on adjacent tanks, is that the slight increase in power cost for the Rectoplater is offset by the complete lack of maintenance and by the fact that the Rectoplater may be used immediately after being turned on in the morning, whereas from one-half to one hour is required in the case of a motor generator to obtain stable operating conditions.

For the same capacity, Rectoplaters cost less than motor generator sets. The installation cost of a Rectoplater is practically negligible, whereas in the case of motor generator sets, it is usually necessary to install a concrete base and to employ a contractor to wire the motor generator to the external switchboard. Considering the lower initial cost, plus the advantages and operating economies outlined above, Rectoplaters are destined to fulfill an important part in the electroplating power supply field in the future.

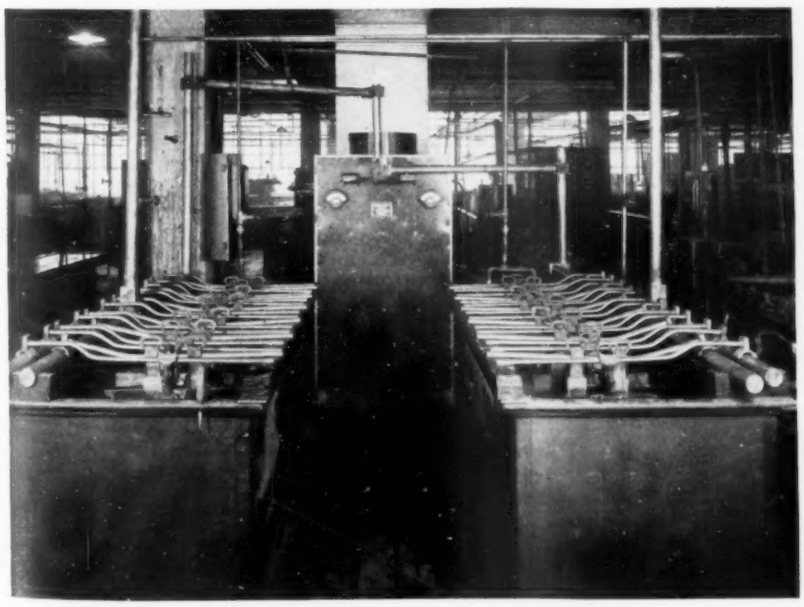


Fig. 5. Mallory 3000 amperes 7½ volt Rectoplater.

Rack Coating

United Chromium, Inc., 51 E. 42nd St., New York, have announced the sale of "Rack Coating-W," a new material which has been designed primarily for the purpose of coating plating racks of all descriptions with a material which will not be affected by boiling cleaners or general plating solutions, including chromium, and which contains no ingredients which are in any way harmful to plating baths.

The material is white in color so that any uncovered portions of the racks should be readily seen. The manufacturers state that no blisters or cracks have been evident in coatings which have been subjected to months of continuous use in plating cycles.

The coating is applied by dipping the rack in Unichrome Rack Coating-W, and each coat is force dried at a temperature of about 200° F., for about one hour. Ten coats are usually applied.

Improved Control Stand for Electric Soldering Irons

The Electric Soldering Iron Co., Inc., Deep River, Conn., has announced an improvement in its control stand for controlling the heat in an electric soldering iron when not in use.

According to the manufacturers, this stand can now be used either on AC or DC current, making it possible for every user of electric soldering irons to have this control stand regardless of the current used.

Soldering operations, especially in industrial use, require a very hot iron. Between operations, when the iron is idle, it has been necessary to turn the current off or else the continued high temperature burns off the tinned surface on the tip (if it doesn't result in even burning out the iron entirely). This makes necessary a lot

of work filing and cleaning the tip so that it may be retinned.

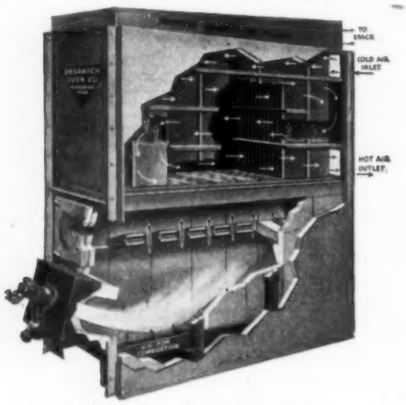
The Esico thermostat control stand, it is reported, is so designed that any make of electric soldering iron may be used in it, cutting the iron in and out of the circuit at any selected temperature required for the work in hand. It claims to save time for the workman, greatly increase the life of the soldering iron and make a saving in electric current.

Indirect Air Heater

The Despatch Oven Co., Minneapolis, Minn., have officially announced the development of their new indirect air heater, gas and oil heated, which is recommended for ovens, dryers and space heating.

Briefly, the Despatch indirect air heater incorporates many new features which are said to practically eliminate the maintenance and the replacement of parts that have been necessary on previous heaters of this type which have been on the market for about 20 years.

One feature is the new arrangement of the heat exchanger. It is arranged with a heavy duty alloy cast protecting plate that shields the tubes in the heat exchanger from the radiant heat of the combustion chamber. This added protection feature in the air heaters assists in preventing burned out tubes which are very expensive to replace and which cause costly shut downs in the production line when repairs are being made.



Phantom view of heater.

The heat exchanger consists of 88 individual tubes which increase the normal area for radiation. Tubes are staggered to produce the greatest possible wiping action of the air as it passes through the heat exchanger. Resistance to air passage through the exchanger is very low.

Another feature is that only one burner is used to obtain 500,000 B.T.U. rating. This is 50% to 75% less number of burners than are required on available indirect air heaters of the same B.T.U. rating. Of course, the smaller number of burners per installation reduce maintenance costs, and the possibility of becoming out of adjustment.

The burner equipment used is a low pressure proportioning type, which keeps a constant ratio between the air and the fuel being used, whether gas or oil. The perfect proportioning promotes, it is reported, high efficiency of operation but most important, eliminates soot and dirt which reduce maintenance of cleaning heat exchanger tubes to an absolute minimum.

Another feature is the arrangement of the combustion chamber so that there is no flame impingement on metal parts. This assures long life of the heat exchanger parts.

Portable Electric Reciprocating Sanding—Rubbing—Polishing Machine

Detroit Surfacing Machine Co., 7433 W. Davison St., Detroit, Mich., has introduced the Easy electric sander, a portable all-electric reciprocating motion sanding, rubbing and polishing machine.

It is adaptable to a wide range of new and refinishing applications on flat, curved and irregular surfaces—sanding, rubbing or polishing, from the finest precision work to roughest castings: on wood, metal, bakelite, granite, slate, leather or composition surfaces—primer, surfacer or sealer coats, shellac, varnish, lacquer, enamel and other materials.

The machine, it is stated, has the following advantages: perfect balance; light weight, only 6¼ pounds; comfortable grip; convenient switch control; smooth reciprocating motion; easy one-hand operation on horizontal or vertical surfaces.

Ample power is furnished by a sturdy, ball bearing, Universal motor, operating from any AC or DC electric light socket. Ball bearing construction is employed throughout and every moving part is said to run in grease packed and grease sealed precision selected ball bearings. Ball bearing thrust with inner and outer races press locked in place eliminates drive shaft shock in all directions. A large fan mounted on the motor shaft provides forced ventilation cooling, and a filter installed in motor cap removes injurious grit and debris from air before entering motor.

One third of a standard size sheet of abrasive (any kind or grit) is said to fit the Easy without waste. A new improved type of abrasive holder has been developed which claims to hold the abrasive paper tightly on the sanding pad, thus eliminating loss of cutting action commonly experienced when abrasive paper is loose on pad. From one to several pieces of paper can be quickly and securely attached at one time.

Portable electric sander.

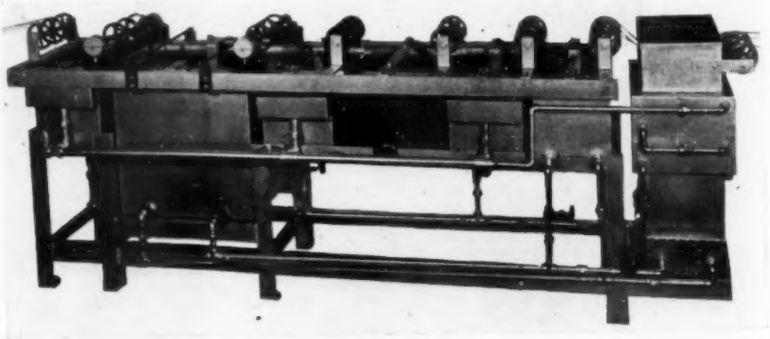
Continuous Wire Plating Machine

Manufacturers of musical strings, radio tube filaments, nettings and similar products which are now frequently made from steel or copper wire and subsequently coated with other metallic finishes, should be interested in the design and performance of the improved wire plating machine illustrated herewith and produced by Munning & Munning Inc., 202-208 Emmett Street, Newark, N. J.

These units are furnished for single or multiple operations to meet the conditions of the problem and one or as many strands as may be necessary for production purposes can be simultaneously drawn through the machine in parallel.

It is also possible, due to the flexibility of the arrangement, to permit different wires to receive totally dissimilar treatments while running normally on others, by omitting intermediate steps in the sequence.

The apparatus pictured contains seven distinct processing tanks, and is engineered to provide ease of control: accessibility of all parts; water, drain and electrical connections, and requires only to be set in location to begin actual plating. The pay-off and take-up mechanism for the reeling and unwinding of the coils are not shown in the cut.



Machine for continuous wire plating.

Flux for Gas Welding Aluminum

A free flowing flux for gas welding of aluminum and aluminum alloy shapes, has been placed on the market by Park Stewart, 514 Western Ave., Aspinwall, Pa. Known as "Flo-Ez-Flux," it is packed in 15, 5, 2, 1 and ¼ lb. glass containers, such as shown

Flux is packed in non-corroding, moisture proof, glass containers which preserve its useful life.

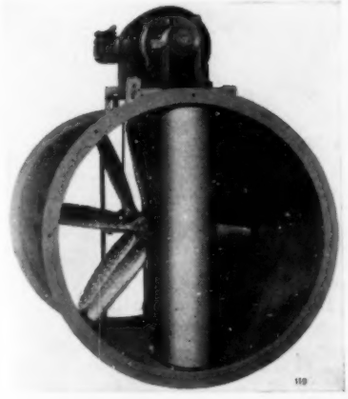
in the illustration. These containers do not corrode, as do metal containers, and they protect their contents at all times from moisture contained in the air, thus assuring an absolutely pure flux which will not cake or harden. The 15 lb. container is equipped with a handle for easy carrying.

Flo-Ez-Flux is claimed to stay suspended longer than the ordinary flux and is finely ground to give a smooth weld, saving the cost of dressing. It may be used to gas weld either wrought, cast or high tensile aluminum or aluminum alloys, of any size or shape where welding is possible. The manufacturer will furnish prices on request.

New Propeller-Type Blower

A new propeller-type fan blower, with motor located on top of the blower housing, entirely out of the air stream, has just been announced by the Hartzell Propeller Fan Company, of Piqua, Ohio.

This new blower, its makers say, meets the demand for a propeller-type blower which can be used in moving air at high temperatures, or in which the presence of acids or other elements might damage the motor.



Propeller fan.

Construction of the unit is extremely simple and correspondingly sturdy. The motor is mounted on top of the blower housing. One side of the platform on which it rests is hinged, and lock bolts on the opposite side can be adjusted to tighten or loosen the belt, or to change it. A V-type belt is used to transmit power from motor to fan shaft, and this belt can be replaced from outside of the blower. The belt is protected inside the blower by a steel guard. The entire unit is patented, and the patented Charavay Tear-Drop propellers are incorporated. It is claimed that these propellers represent a new advance in propeller-type fan operation, in that they give high air deliveries against heavy back pressure unlike the ordinary propeller-type blade.

The new blower is delivered complete with housing, and can be installed with minimum labor in any existing duct. It is made in twelve standard sizes, with propellers from 18″ to 48″ in length, and can be built in other sizes to meet special needs.

Angle Type Spray Nozzle

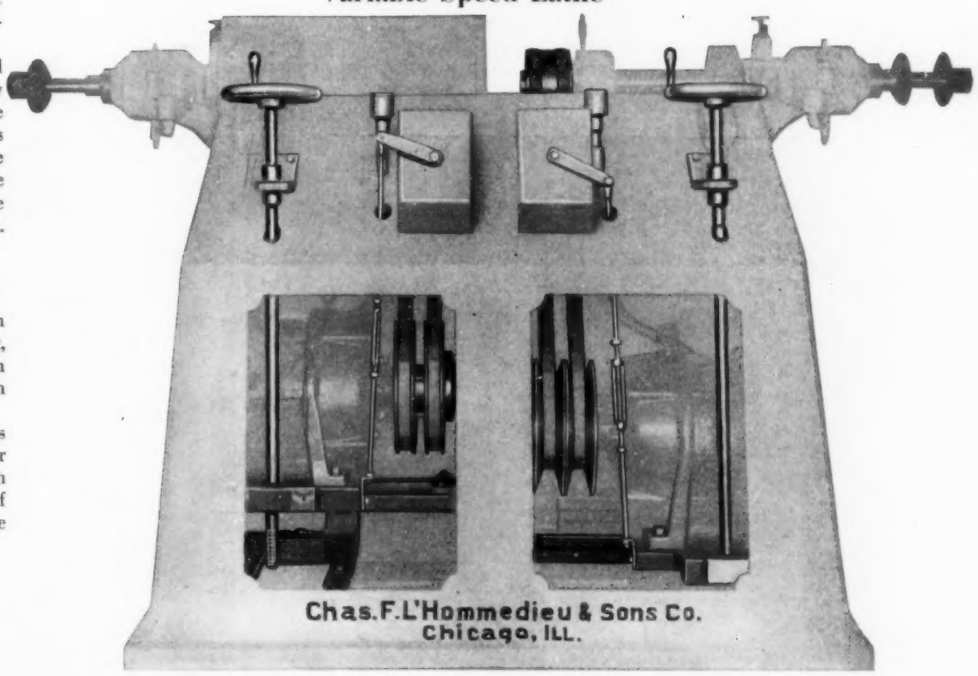
Spraying Systems Co., 4922 W. Grand Ave., Chicago, Ill., has placed on the market a spray nozzle called Whirljet Angle Type. The nozzle is reported to be non-clogging and to produce a hollow cone spray with uniform distribution.

Angle type spray nozzle.

These nozzles are sturdily constructed and have large passages making them practically clog-proof. Pipe connection is ⅜″ male, and they are available in 6 different capacities from 0.5 to 2.5 G.P.M. at 10 pounds pressure. Standard stock construction is brass; other metals can be specified.

The nozzles are recommended for air conditioning, air washers, air coolers, brine spraying, chemical processes or wherever it is necessary to have a non-clogging, centrifugal type nozzle with pipe connection parallel to direction of spray.

Variable Speed Lathe



Rear view No. 18 Variable Speed Lathe.

A new line of variable speed lathes has been developed by Chas. F. L'Hommedieu & Sons Co., 4521 Ogden Ave., Chicago, Ill., for which remarkable economies in buffing costs are claimed. These lathes are available in small bench types and in the larger pedestal types. The lathes are designed to give a speed range from fifteen hundred to three thousand R.P.M. However, speeds above or below these values can be obtained. The speed is changed by merely turning a handle while in operation and the speed obtained is easily noted from an indicator furnished with the lathe.

The maintaining of constant peripheral speed of the buff, it is claimed, will result in economies of buffing composition and labor which will soon amortize the investment for the lathe itself.

When large buffs are reduced to smaller diameters, they no longer need be discarded inasmuch as constant peripheral speed can be maintained by a simple hand adjustment thus resulting also in savings on buffing wheel costs.

Manufacturers' Literature

Belts. "Belting Biographies," a booklet describing transmission and conveyor belts, giving case histories. It also contains technical information, including data on the selection of the proper belt, installation, speed of operation, etc. Mechanical Goods Division, U. S. Rubber Co., 1790 Broadway, N. Y. City.

Coloring Iron. A booklet describing "Du-Lite" Process 290, a metal primer for enamel, lacquer or paint, and "Du-Lite Process" 950, for producing black finishes on steel and iron castings, tool steel, bronze, brass and copper parts. Du-Lite Chemical Co., Highland Ave., Middletown, Conn.

Dust Determinations. Bulletin CT-4 on the M.S.A. microprojector, claiming the following advantages: samples are counted more rapidly and with less eyestrain; concentrated samples are counted without dilution; dust particles are more easily distinguished from pits, bubbles, etc., and particle size is more accurately estimated. Mine Safety Appliances Co., Braddock, Thomas and Meade Sts., Pittsburgh, Pa.

Flame Control. Bulletin 1001-1 featuring "Flame-Otrol" combustion safeguard, which incorporates the same internal circuit as model 1101-A, but is smaller in size, has fewer contacts and sells in a lower price range. It is designed to fill the needs of less elaborate installations, yet is said to render the same protection against explosion. Wheelco Instruments Co., 1929 S. Halsted St., Chicago, Ill.

Grinding Machines. A folder covering Norton Hi-Swing machine, angular Wheelslide machine, 14" D-plus machine, Type C cylindrical grinder and No. 24 Hyprolap machines. Norton Co., Worcester, Mass.

Jar Mills. Bulletin No. 250 on "Roller-Type" jar mills, which require no clamping into frames or housings—just setting the jar on the revolving rollers. They are of rubber-covered steel and are mounted in brass-bushed bearings. Standard sizes are arranged to accommodate one, two, three or four "Loxeal" jars, either of the 1, 1½ to 2 gallon-size. The U. S. Stoneware Co., 60 East 42nd St., New York City.

Laboratory. A folder discussing inspection and testing of materials and appliances used in building construction—for architects, contractors and owners. Pittsburgh Testing Laboratory, Koppers Bldg., Pittsburgh, Pa.

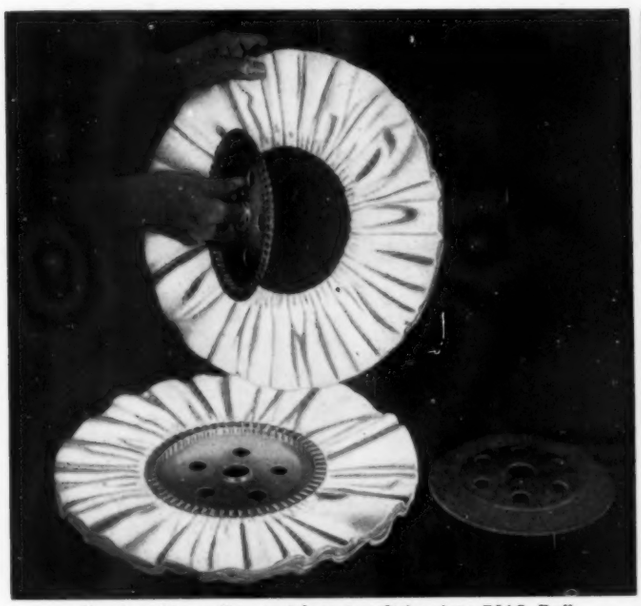
Lamp Hangers. Catalog No. 39 showing the redesigned line of hangers, lamp shock absorbers, suspension fittings and related accessories, with the addition of new models and new accessories of the Thompson Electric Co., 1101 Power Ave., Cleveland, Ohio.

Manganese Steel. Catalog No. 59, which is devoted to "Amsco" manganese steel, recommending this metal for crushing, grinding and pulverizing equipment, dredging equipment, clay products equipment, construction, excavating and road building equipment, etc. American Manganese Steel Div., American Brake Shoe & Foundry Co., Chicago Heights, Ill.

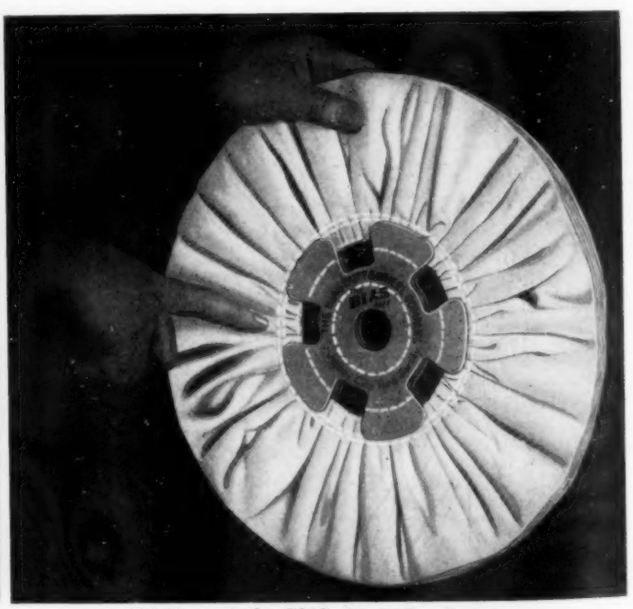
Nickel Alloys. Folder which contains basic information on mechanical, corrosion-resistant and other properties of rolled nickel, Monel and other high nickel alloys produced by the International Nickel Co., Inc., 67 Wall St., New York City.

Plastic and Liquid Rubber Compounds. This catalog covers Selfvulc process for defeating the inroads of both corrosion and abrasion. Self-Vulcanizing Rubber Co., Inc., 605 W. Washington Blvd., Chicago, Ill.

Plating Equipment. Bulletin No. 12, which is the first of a series that will be issued on new developments and products for the plating industry. The catalog is well illustrated with products available to the electroplating industry, and contains discussions on tanks, generators, polish-



Showing Air cooling metal center fitting into BIAS Buff



Pointing out the BIAS Air cooling feature

Some of the Features of BIAS Air-Cooled Buffs

Bias air-cooled buffs can be operated at very high speeds without burning, due to free air circulating through the metal center discs. The Bias air-cooling system lengthens the life of this buff, and insures economy and satisfying service, at these high speeds.

The well known Bias principles of construction—forming of cloth—skilled workmanship, all of which have characterized the noted BIAS Buff, are used in all Bias Air-Cooled Buffs.

You'll like this new air-cooled member of our line. Try it.

The BIAS BUFF & WHEEL Company, Inc.

428 Communipaw Ave. Jersey City, N. J.

WARNING NOTICE. The Bias Buff & Wheel Co., Inc. are licensed by the Jackson Buff Corporation of Long Island City, New York, with full rights to manufacture under U. S. Patents No. Re. 18,894 and No. [illegible] which have broad claims covering an air-cooled buff having means for the admission of cooling air through the sides of the buff. Manufacturers of buffs are warned against infringement of the claims of these patents as the owners and the licensee intend to protect their rights under these patents and stop infringement. Also U. S. Patent 2,004,623

ing and buffing compounds, barrel plating units, current control devices, polishing and buffing equipment, and many chemicals, tools and accessories needed for plating. Munning & Munning, Inc., 202 Emmett St., Newark, N. J.

Polishing Equipment. This bulletin shows various types of round, out-of-round, flat, tapered, tubular and irregular contoured work being polished and buffed by the new semi-automatic polishing and buffing heads for use with double spindle lathes made by the Continental Roll & Steel Foundry Co., Industrial Equipment Div., East Chicago, Ind.

Portable Drills. Catalog No. 39, describes "Jasco" ¼" junior drill, "Clark" 3/16", ¼", 5/16", ⅝", ½", ⅜" and ¾" ball-bearing drills; drill stands, "Clark Tu-Spede" ball-bearing sander and polisher, aerial grinders, etc. Jas. Clark, Jr. Electric Co., Louisville, Ky.

Testing Equipment. This bulletin features the Dwyer CO_2 indicators and draft gages. Made of crystal clear plastic material, all parts are visible and breakage is claimed to be entirely eliminated. They can be carried in any position. F. W. Dwyer Mfg. Co., 565 W. Washington Blvd., Chicago, Ill.

Zinc Die Castings. This data book contains the following chapters: general considerations, bending and forming, broaching and shaving, buffing, burnishing and tumbling, drilling, facing, filing and burring, gear cutting, grinding and polishing, knurling, milling, planing and shaping, punching, reaming, riveting, sawing, spinning, swaging, tapping, threading and turning. The New Jersey Zinc Sales Co., 160 Front St., New York City.

Technical Publications

Progress of Tin Research. Report for 1938. Publication No. 94. May 1939. International Tin Research & Development Council, 149 Broadway, New York.

Report of Investigations. Progress Reports—Metallurgical Division, R.I. 3441. U. S. Department of the Interior, Bureau of Mines, Washington, D. C. Volumetric determination of molybdenum.

Associations and Societies

American Electroplaters' Society

Chicago Branch

On Saturday, July 8th, the Branch met in the Atlantic Hotel, Chicago, to hear the report of the delegates to the annual convention at Asbury Park. The consensus of opinion was that the papers to be read at the convention should be previously edited and approved by a committee appointed by the supreme president, and if possible, to have copies of the papers mailed to the membership of the Society at least a month before the convention opens, so that the papers might be read and studied, allowing for better prepared discussion.

It was also suggested that fewer papers and papers more intimately related to electroplating of metals be presented, and that each paper be an original presentation.

Delegates *Frank Hanlon* and *H. A. Gilbertson* made the reports; *C. S. Tompkins*, correspondent.

Detroit Branch

The Detroit Branch will hold its annual picnic and summer get-together on Saturday, August 5th at Sandy Mac's golf course. The all-day outing will include golfing in the morning, noon-day lunch with the usual dish of sweet corn, and events for prizes in the afternoon.

Members of other branches are cordially invited to attend. Admission $1.00. *Wright Wilson* is secretary.

CHROMIC ACID

Recognized as the world's largest manufacturer of chromium chemicals, Mutual brings to the plating industry a basic source of chromic acid.

Our facilities cover every step in its production, from the mining of the chrome ore on a remote island in the Pacific to the wide distribution of the finished product through warehouse stocks in the principal consuming centers.

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Mines in New Caledonia
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Electrochemical Society

The Fall meeting of the Society will take place September 11-13 in New York City, with the Hotel Commodore as headquarters.

On Monday afternoon members and guests of the Society will meet in the Hall of Science at the World's Fair Grounds. *Dr. Bradley Stoughton* of Lehigh University will deliver the Sixth Joseph W. Richards Memorial Lecture at this time. The topic of his address will be "Modern Marvels of Electrochemistry."

On Tuesday evening the Acheson Medal Dinner will be held at the Hotel Commodore. *Dr. Francis C. Frary*, recipient of the medal and prize will deliver a short address on "Electrochemical Recollections."

The Monday morning session will be devoted to "Recent Progress in Electro Analysis" in charge of *Professor Hiram S. Lukens* of the University of Pennsylvania. The Tuesday morning session and probably

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likewise the Tuesday afternoon session will be devoted to "Influence of Cathodic Reactions on Corrosion" in charge of *Dr. Robert B. Mears* of the Aluminum Co. of America. There will be a round table luncheon discussion on that day and in the evening will be the Frary dinner. Wednesday morning will be devoted to papers on electrodeposition, batteries, etc., in charge of the Electrodeposition Division.

Metropolitan Section

Raymond R. Rogers, *Secretary-Treasurer*
Columbia University, New York City

The following officers have been elected by the Metropolitan Section for the year 1939-1940:

Chairman—*R. H. Muller*, New York University
Vice-Chairman—*Walter R. Meyer*, Editor of METAL INDUSTRY
Secretary-Treasurer—*Raymond R. Rogers*, Columbia University

Philadelphia Section

Harold J. Read, *Secretary*
Harrison Lab. of Chemistry, Philadelphia, Pa.

The following officers have been elected by the Philadelphia Section for the year 1939-1940:

Chairman—*Milton B. Barba*
Vice-Chairman—*Loren C. Hurd*
Treasurer—*Walter B. Keighton, Jr.*
Secretary—*Harold J. Read*

National Metal Congress and Exposition

William H. Eisenman, Managing Director of the National Metal Congress and Exposition and secretary of the American Society for Metals, has announced that acceptances for joint sponsorship of the Congress have been again approved by the Wire Association, The American Welding Society, The Institute of Metals Division and the Iron and Steel Division of the American Institute of Mining and Metallurgical Engineers, and, of course, the American Society for Metals.

Portions of the program yet to be announced will be devoted to discussions by leaders in the various societies listed. Announcement of the completed program will be available about August 15.

In addition to the previous announcement, regarding capacity of contracts signed for show space, other contract holders bring the total very near to capacity.

According to Mr. Eisenman, all indications point to one of the largest attendance figures on record during the 21 years of the National Metal Congress and Exposition.

Society of Chemical Industry Elects Officers

The American Section of the Society of Chemical Industry announces the election of the following officers for the year 1939-40.

Chairman ..... Wallace P. Cohoe
Vice Chairman ..... Lincoln T. Work
Honorary Secretary ..... Cyril S. Kimball
Honorary Treasurer ..... J. W. H. Randall

The following new Committee members were elected to take the place of retiring members:

L. W. Bass
J. V. N. Dorr
C. R. Downs
J. C. Hostetter
E. P. Stevenson

The Annual Meeting of the Parent Society will be held in Exeter July 10-15 and all chemists are invited.

New Books

Metal Industry Handbook and Directory. 1939. Published by The Louis Cassier Co. Ltd., 22 Henrietta St., London, W.C. 2, England. Size 9″ x 6″; 452 pages.

The book is divided into four sections: namely, (1) General Properties and Mechanical Treatment of Metals and Alloys-Pyrometry-Metal Melting, (2) General Data and Tables, (3) Electroplating-Finishing-Galvanizing, (4) Miscellaneous.

In the present edition of the Handbook, additions have been made to the tabular matter to include figures and data published during the year 1938, and corrections have also been made where necessary.

The section, "Properties of the Principal Metals," has been extensively revised, chiefly for the metals aluminum, copper, magnesium and tin; and also that dealing with "Properties of Some of the Rarer Metals," particularly for beryllium, columbium, lithium, rhodium, tantalum, tungsten and zirconium.

Revision has been effected in the sections dealing with B.S.I. Non-Ferrous Specifications, those for Aircraft Materials, the Air Ministry (D.T.D.) and the Admiralty Specifications, so as to bring these up to date. The details of 17 additional alloys have been included in the Proprietary Alloys section.

With these additions and improvements, the present edition should be found increasingly useful for reference purposes.

Physik. By Dr. Paul Wessel. Published by Ernst Reinhardt, Munich, Germany. Size 8" x 5"; 514 pages; 277 illustrations. Price $2.00.

A textbook in German for students of technical universities. The book presents a clear, precise discussion of the fundamentals of the entire field of physics in a systematic order which has proved itself through many years of teaching. Because of the comprehensiveness of the book, each subject is concisely discussed, but nevertheless, the student is presented a rather complete picture of the elementary principles of physics, written in the modern viewpoint.

A unique feature of the book is an extensive catechism of over 1,400 questions on physics. This catechism should be of great help to the student in determining the extent of his own knowledge of physics.

Metal Spraying. By T. Henry Turner and N. F. Budgen. Second Edition; revised and largely re-written by E. C. Rollason. Published by J. B. Lippincott Co., Philadelphia, Pa. Size 9" x 6"; 226 pages. Price $7.50.

Thirteen years have elapsed since the publication of the first edition of this book, and during this interval new designs of spraying apparatus have been evolved, using wire, powder and molten metal.

The book contains a history of the early attempts on metal spraying and the development of the molten metal spraying pistols. Surface preparation of the basis metal and details connected with surface preparation are considered.

The chapter on the nature of sprayed metal is particularly comprehensive, and some of the subject matter considered therein is: formation and structure of sprayed coatings; adhesion and its measurement; doping; thickness and strength of coating; oxide content; porosity and density; hardness; coefficient of friction and resistance to wear; corrosion of coatings; tests for deposits; resistance to oxidation; solid bodies built up by spraying. A comparison of the metal spray process with other metals of metallization is also made.

Many applications of the metal spray process to constructional work, shipbuilding, chemical industries, repair work, etc., are considered.

The book, on the whole, is a very valuable one in its field.

Year Book of the American Bureau of Metal Statistics. 1938. Published by the American Bureau of Metal Statistics, 33 Rector St., New York City. Size 10½" x 8¼"; 120 pages. Paper bound. Price $2.00.

This is the 19th annual issue of the valuable book of statistics on the metal industry.

Complete details are given on the world's consumption, production and operating details of copper, lead, zinc, gold and silver.

A mass of technical data on platinum, antimony, arsenic, nickel, tin, aluminum, cobalt and other metals is given.

Machine Design. By S. E. Winston of Armour Institute of Technology, Chicago. Published by American Technical Society, Chicago. Size 8½" x 5¾"; 326 pages. Price $3.00.

A textbook presenting the fundamentals of the theory and analysis which are basic to the field of machine design. The author, S. E. Winston, is associate professor of Mechanical Engineering at Armour Institute of Technology, Chicago.

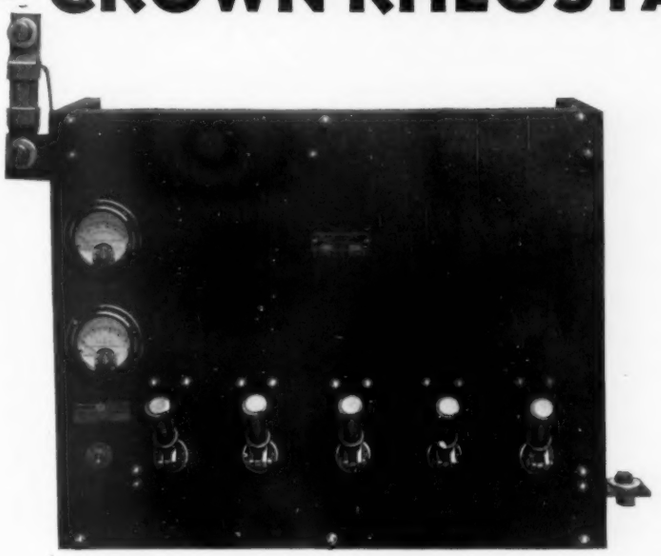
The book is well printed, replete with examples and typical problems.

The chapters are: fundamental principles-simple stresses; fundamental principles-compound stresses; bolts and screws; cylinders and riveted joints; shafting and keys; couplings and clutches; wrapping connectors and their pulleys, sheaves or sprockets; friction drives and spur and bevel gears; miscellaneous details of design.

This book should be of value both to the student of machine design and the working machine designer.

The 25th ANNIVERSARY of BETTER TANK CONTROL with

CROWN RHEOSTATS



Crown Rheostat & Supply Co.

Complete Plating and Polishing Equipment

1910 Maypole Avenue, Chicago

• P.S. Have you ever Polished and Buffed Steel in one operation at 400 RPM? Write and ask us now.

Obituaries

William G. Purdy

William G. Purdy, 62, founder, president and general manager, Tiffin Art Metal Co., Tiffin, Ohio, died May 10, following a brief illness.

William L. Bechtold

William L. Bechtold, treasurer of the New York Brass Foundry Co., 403 Broome St., New York City, died at his home in Brooklyn, N. Y., on June 29, at the age of 42 years, after an illness of about two years. Mr. Bechtold had been an active member

EGYPTIAN
PERSPIRATION RESISTING LACQUER

Perspiration Resisting Lacquer offers unusual resistance to body acids encountered by frequent handling . . . It air dries in usual lacquer drying time but maximum resistance may be hastened by force drying . . . Produces a hard film, extremely durable to wear and tear.

Perspiration Resisting Lacquer may be used on brass, copper, bronze, oxidized copper, gun metal, iron and steel as well as polished copper, aluminum and nickel.

Further details of Egyptian Perspiration Resisting Lacquer will be furnished upon request.

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In addition to hundreds of Clear Lacquer formulations made to meet standard and individual requirements, we also make a complete line of pigmented lacquers and Synthetics. Ask for details.

EGYPTIAN FINISHES

THE EGYPTIAN LACQUER MFG. CO.
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of the firm for more than twenty years, and his father John J. Bechtold, president, founded the company. He is survived by his wife Virginia Goldsborough Bechtold, two daughters and a son.

Frederick C. Hersee

Frederick C. Hersee, president and general manager of the Cambridge Screw Company, died at his home in Belmont, Mass., on May 16th. He was born and educated in Roslindale, Mass., and manufactured machine products for forty years. Mr. Hersee also was a pioneer in the manufacture of automobile accessories.

Jonathan Edmund Browning

Jonathan Edmund Browning, one of three Ogden, Utah, brothers who founded the arms manufacturing company that bears their name, died at New Haven, Conn., May 16, having been stricken ill while conferring with officials of the Winchester Repeating Arms Company. Mr. Browning was 80 years old, and the craftsman of his company.

William R. Conlon

William R. Conlon, associate member of Detroit Branch A.E.S., passed away June 6, at Harper Hospital in Detroit. He was buried at Muskegon, Mich., the city where he spent his boyhood and school days. After graduation, Mr. Conlon came to Detroit and became employed by Collard. Inc. In 1937 he became connected with Automotive Rubber, Inc., and served as plant superintendent from that time until his death. He was born at Brantford, Ont., on April 13, 1911, but was brought by his parents to Muskegon, Mich., at the age of nine. Mr. Conlon's many friends in the plating industry will miss his likeable presence, and the Detroit Branch will miss his loyal support.

Personals

M. M. Beckwith, for the past three years in charge of the Chemical Laboratory of the Guide Lamp Division of General Motors Corporation, has recently joined the staff of The J. B. Ford Sales Company, Metal Cleaning Department. Dr. Beckwith will operate from Wyandotte, Michigan, the home office of the manufacturers of Wyandotte Metal Cleaners, and will devote his time to practical and technical study of economical metal cleaning methods.

Dr. M. M. Beckwith

Dr. Beckwith is a graduate chemical engineer, and secured his Ph.D. degree after 8 years of study at the University of Illinois, majoring in analytical chemistry, and also studying applied mechanics and industrial uses of the X-ray. He has also had considerable practical experience and was the co-author of the article given the Proctor Award at the 1938 National Electroplaters' Convention. The article was entitled "Rochelle Salt Cyanide Copper Plating Baths."

George Millspaugh of Thomaston, Conn., is now associated with the Lacquer & Chemical Corporation, 214 Fortieth St., Brooklyn, N. Y., in a selling and servicing capacity. He was formerly connected with the Seth Thomas Clock Company, having had ten years' experience in the plating and metal finishing department of this concern.

Dr. James E. Wilson, metallurgist of the Bausch & Lomb Optical Company's Research Staff, was awarded the Second Photographic Exhibit and Competition award of the American Society for Testing Materials, at the Society's 42nd annual meeting in Atlantic City. The award was made to Dr. Wilson for his excellent photomicrograph in color of chromic oxide in a chrome nickel alloy, taken in polarized light at a magnification of 250X.

C. F. Goldcamp has been appointed to succeed the late *J. D. Allen*, as manager of sales, Cold Finished Department of the Jones & Laughlin Steel Corp., Pittsburgh, Pa. Mr. Goldcamp's entire business experience has been with J & L, having started with the company in 1923 shortly after his graduation from Lehigh University as a chemical engineer. His first position with Jones & Laughlin was in the inspection department of the Pittsburgh Works and in 1924 he became assistant chief inspector. In 1926 he was made chief inspector of the Soho Works and in 1930 was transferred to the general metallurgical department as contact man for hot rolled and cold finished products. In 1935 he was made a salesman in the Cold Finished Sales Department.

Col. A. L. Mercer, President, Cowles Detergent Company and *Harold L. Trembicki*, Manager of the Metal Cleaning Department, announce the appointment of *Newton P. Armstrong* as the Cowles representative in New England, with headquarters in Boston. Mr. Armstrong is a Culver man, and has been associated with the Paint and Warehouse Division of the Pittsburgh Plate Glass Company, the Hetzel Roofing Products Company, the Sapolian Company and Oakite Products over the past several years. Mr. Armstrong's experience in metal cleaning particularly fits him to represent the Cowles Detergent Company.

Col. Mercer and Mr. Trembicki also announce the appointment of *Frederick H. Hitchcock* as the Cowles representative in Detroit and the state of Michigan, with headquarters in Detroit. Mr. Hitchcock is a graduate of State Teachers College, Mansfield, Pennsylvania; and after spending two years as principal and instructor of Simsbury, Connecticut, grade school, he entered the industrial sales field and has been associated with the New York Edison Company, Oakite Products, Inc., Almond W. Barnes Soap Company and Herz Manufacturing Company. Mr. Hitchock has had a broad experience in the metal cleaning field, and is particularly fitted to sell and service products in the Detroit industrial area.

Farrel-Birmingham Co., Inc., Ansonia, Conn., announces the following personnel changes: *George Schaefer*, formerly rolling mill design engineer, has been appointed manager of the rolling mill machinery sales division to succeed *Norman Shaw*. Mr. Shaw has been appointed manager of the company's Chicago office, located at 1059 First National Bank Bldg. He will succeed *Harry Temporal* who is being transferred to the Buffalo Division. *Edward S. Coe*, who has also been connected with the Chicago office, is being transferred to the rolling mill machinery sales division in Ansonia.

E. C. Wickersham has resigned from the sales department of the Howell Electric Motor Co., Howell, Mich., to become an assistant to the sales manager of the Leland Electric Co., Dayton, Ohio.

Richard Rimbach has been appointed technical advisor to *R. C. Enos*, president of Standard Steel Spring Co., Coraopolis, Pa. Mr. Rimbach will work on the development and promotion of a new process for coating steel with a pore-free metallic coat which, it is said, has successfully demonstrated its resistance to severe corrosion conditions in the Texas oil fields. The new coating promises to expand the market for steel where corrision now precludes its use. It will be especially advantageous in the manufacture of barrels, tanks, tubing, wire, etc., where corrosion resistance is essential. Mr. Rimbach was formerly director of research, Standard Steel Car Co., editor of Metals and Alloys, and more recently consulting metallurgical engineer. He has written a number of articles for the technical press, translated several books and is supervisor of the Department of Metallurgy's Extension and Evening Courses at the Carnegie Institute of Technology.

G. M. Bowen has been elected president of Ross Operating Valve Co., Detroit, Mich., following the death of *C. A. Ross*, founder and president.

Samuel Glasstone, lately of the University of Sheffield, England, has taken up permanent residence in the United States and is at present engaged in research and writing at the Frick Chemical Laboratory, Princeton University.

How About Your Polishing and Buffing?

Is It Too Slow?

Too Costly?

Switch Over to Acme!

Ten chances to one, you can solve your problem with an Acme Automatic—increasing production, reducing costs, and turning out a more uniformly finished product.

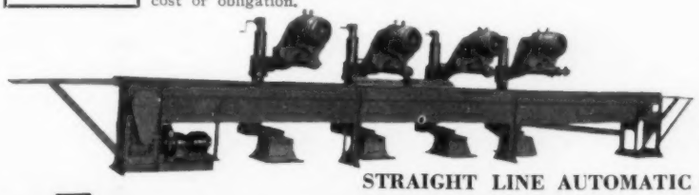
Take, for example, the machine shown at the right. With a head that can be adjusted vertically, horizontally or angleways for cross-cutting, it can be used in conjunction with straight line, rotaries, ends of rolling mills and other types of holding equipment.

Adjustable Floating Head POLISHING LATHE

What's Your Problem?

Acme Machines are made in many different types — each one designed to handle a particular buffing or polishing operation more speedily and more economically. Tell us what's bothering you and we'll supply the answer—without cost or obligation.

Send Sample for **FREE** Production Estimate



Polishes or buffs grilles, mouldings, strips, etc.

STRAIGHT LINE AUTOMATIC

ACME Manufacturing Co.

1642 HOWARD ST. • DETROIT, MICH.

Builders OF AUTOMATIC POLISHING AND BUFFING MACHINES FOR OVER 25 YEARS

Get down to a chemically clean surface quicker and surer than you've ever done before. Employ the new benefits of really thorough rinsing. Eliminate uncertainty and cut your overall cleaning costs.

MAGNUS ELECTREX

is the name of a unique new series of Magnus Cleaners perfected to bring to the electrocleaning operation the rapid wetting, penetrating and dispersing effects which characterize the modern Magnus line of cleaners.

ELECTREX insures more thorough, faster cleaning and very free rinsing, ending the troubles caused by contamination of succeeding rinses and dips. It is acid and hard water-proof, forming no troublesome scums by drag-over.

Let us recommend the right grade of ELECTREX to meet your specific electrocleaning operations. You'll find it well worth your while to try out this new cleaner at your earliest opportunity.

ELECTREX

No. 21-X for die cast and soft metals
No. 22-X for brass
No. 23-X for steel & brass
No. 24-X for steel

Order a trial drum now. Try it out. If, at the end of thirty days, after following our simple directions, you are not completely satisfied, send back the unused portion for complete credit on the entire drum.

MAGNUS CHEMICAL COMPANY

Manufacturers of Cleaning Materials, Industrial Soaps, Metallic Soaps, Sulfonated Oils, Emulsifying Agents and Metal Working Lubricants.

11 South Avenue **Garwood, N. J.**

Magnus CLEANERS

Morris E. Leeds, founder and president of the Leeds & Northrup Company, 4911 Stenton Ave., Philadelphia, Pa., has assumed the position of chairman of the Board of Directors, and *Charles S. Redding*, vice-president in charge of research and engineering, became president, in an expansion of the company's executive set-up recently. Chairman of the Board is a post newly created to facilitate Mr. Leeds' participation in policy matters with which he will continue active.

L. D. Burnell, president of Crobalt, Inc., Detroit, Mich., makers of Detroit non-ferrous cutting tools, wear plates, etc., has announced the appointment of *Heartly W. ("Hunk") Anderson* as sales representative. Mr. Anderson is a practicing civil engineer, and was graduated from Notre Dame. During the past few years Mr. Anderson's interests and experience have been concentrated in the field of metallurgy, particularly in connection with production cutting tools. All products of Crobalt Inc., are now sold direct to the user or to machine tool manufacturers and tool shops.

Cutler-Hammer, Inc., Milwaukee, Wisc., announced the appointment of *B. M. Horter* as general sales manager of the company. He will have direct supervision of sales. Mr. Horter was formerly in charge of the resale sales division at Milwaukee.

Verified Business Items

Sherron Metallic Corp., 1185 Flushing Ave., Brooklyn, N. Y., metal products, has filed plans for extensions and improvements in plant. Cost about $50,000. Departments: drawing, stamping, soldering, brazing, welding, grinding, polishing, degreasing, cleaning, lacquering, enameling and finishing. Principal base metal used is steel.

Rea Magnet Wire Co., Pontiac St., Fort Wayne, Ind., manufacturer of electrical wire and cable, has let contract for a one-story addition, 90 x 120 ft. Cost close to $50,000 with equipment. Departments: drawing and enameling.

Riehle Testing Machine Division of American Machine and Metals, Inc., have moved their general sales and advertising departments to East Moline, Ill.

Markel Electric Products, Inc., 145 E. Seneca St., Buffalo, N. Y., manufacturers and designers, are contemplating increasing facilities of their press department. Cost about $2,500.

Lincoln Electric Railway Sales Co., Marshall Bldg., Cleveland, Ohio, announces the appointment of *Thomas V. Brooke* as sales engineer with its Chicago office. Mr. Brooke is a graduate of Virginia Military Institute and for several years has been associated with the Lincoln Electric Company as a research engineer.

The Lea Mfg. Co. of Waterbury, Conn., manufacturers of greaseless compositions, polishing and buffing compounds, announces the appointment of *William D. Starr* to its research staff. Mr. Starr, Yale '27, was formerly manager of the Eastern Engineering Co. of New Haven.

Wheelco Instruments Co., 1929 S. Halsted St., Chicago, Ill., has appointed Industrial Equipment Co., 732 M & M Bldg., Houston, Texas, and Frank P. Fischer, 1608 Audubon St., New Orleans, La., as dealers in their respective territories.

Jewelers Technical Advice Co., formerly at 136 Liberty Street, New York City, is now located at 123 William Street, N. Y.

United Aircraft Corp., East Hartford, Conn., has let general contract for a one-story addition, 150 x 450 ft., to its Sikorsky Aviation Div., Stratford, Conn., to be occupied by Chance Vought Aircraft Div., which will be removed from East Hartford as soon as new structure is ready. Cost over $200,000 with equipment. Departments operated: rolling, drawing, pickling, spinning, stamping, brazing, welding, grinding, sand-blast, polishing, degreasing, cleaning, plating, tumbling, buffing, anodic treatment, lacquering, enameling and finishing. Principal base metals used: steel, bronze, zinc, aluminum and lead.

Independent Pneumatic Tool Co., Chicago, Ill., has opened a branch office at 1544 Broadway, Denver, Colo. The new branch is in charge of *C. A. Turnquist*. The company manufactures Thor-Cochise mining and contractors' equipment and Thor portable electric and pneumatic tools.

Ryan Aeronautical Co., Lindbergh Field, San Diego, Calif., airplanes and parts, is erecting an aircraft factory and office building, the former to be 200′ x 275′, and the latter 42′ x 120′. Cost $150,000. *T. Claude Ryan* is president.

The Wolverine Tube Co., Detroit, Mich., elected the following officers at a meeting of the board of directors recently: *C. C. Limbocker*, chairman; *H. J. Hooks*, president; *G. R. Anthony*, vice president; *O. Z. Klopsch*, vice president and general manager; *J. D. Colyer*, vice president in charge of sales, and *V. D. Hanna*, secretary and treasurer. Mr. Limbocker has been president and Mr. Hooks secretary and treasurer of the company for the past twenty years.

American Manganese Steel Division of the *American Brake Shoe & Foundry Co.*, have expanded their main plant at Chicago Heights, Ill. Six additions and a new administration building were included in this improvement program.

A Resume of Iron Plating

(*Continued from page 377*)

metal were obtained. According to their tests on the physical properties of the deposited, annealed iron, it possessed a tensile strength on the average of over 50,000 lbs. per sq. in. and an elongation varying between 19-27%.

3. *Ferrous Chloride-Hydrochloric Acid Bath*

This bath, most recent of all and most promising from the standpoint of heavy, rapid deposition of soft, ductile iron with excellent properties was proposed by Kasper[11] in 1937 after a series of experiments at the National Bureau of Standards. The following is the recommended formula:

0.5N $FeCl_2$ (6.7 oz. $FeCl_2 \cdot 4H_2O$ per gal.)
0.1N HCl (1.6 oz. Conc. HCl per gal.)

The temperature used is 222°F. and the current density recommended is 186 amperes per sq. ft. although he asserts greater densities can be employed. The optimum cathode efficiency is 85%. Armco iron anodes are used, bagged in blue asbestos cloth (crocidolite). There are several precautions that must be observed in employing this solution:

1. The solution on preparation should appear clear green in color. This insures the absence of ferric salts which reduce cathodic efficiency and cause brittle deposits.
2. The ferrous chloride concentration must be maintained between 0.4 and 0.5 normal, because below this, deposits have a tendency to become brittle.
3. Introduction of KCl into the bath will cause brittle deposits.
4. Before use, any ferric chloride that may be present is reduced and heavy metals

INTER-OFFICE MEMO

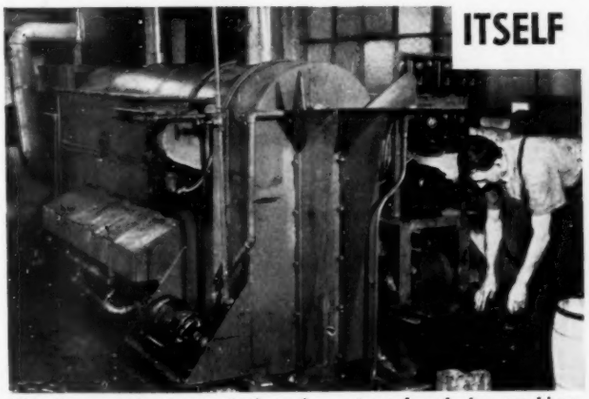
TO A.S.

FROM J.W.

SUBJECT Pre-finished Metals

I wonder if we're not overlooking a good bet? I understand pre-finished metals are now being used for practically all types of products and manufacturing operations. Why can't we use them, too? They mean the complete elimination of plating and polishing operations - and that means plenty of production savings for us! Please write to the AMERICAN NICKELOID COMPANY, 8 Second Street, Peru, Illinois for their free booklet that tells the whole story and shows how others are using the metals. Bring it in when it comes and we'll go over it together.

This Wash, Rust-proof and Dry Machine PAYS for ITSELF IN A YEAR



This is one of our standard wash, rust-proof and dry machines, consisting of soaking wash, spray wash, drain, oil spray, drain and dry. Will handle 900 lbs. of product per hour. For details of this and other Ransohoff Equipment, write for Catalog 40.

A nationally prominent bolt and nut manufacturer reports:

"Since installing the Ideal Continuous, wash, rust-proof and dry machine for metal parts, it has saved sufficiently to pay for itself in one year's operation. The work is finished better than with older methods, and at greater speed and considerably lower manufacturing cost."

IDEAL
TRADE MARK REG. U.S. PAT. OFF.

N. RANSOHOFF, INC. • 202 W. 71st Street, Carthage • CINCINNATI, OHIO

ALUMILITE
EXTRUSIONS
Polishing — Processing
Architectural Work A Specialty

TANK SIZE 25 Ft. Long, 5 Ft. Deep, 3 Ft. Wide

ALUMINUM FINISHING CORPORATION
1119 East 22nd Street
Indianapolis, Ind.

NICKEL SILVER
Sheets — Rolls
Phosphor Bronze, Bronze Gilding Metal
Low Brass and Special Alloys

WATERBURY ROLLING MILLS, Inc.
Waterbury, Conn.

are precipitated by the introduction of pure iron strips and hydrochloric acid into the bath.

5. At the start of a run, extra care must be taken as the temperature and the pH tend to change quite rapidly. It is best to use a "break-in" or dummy cathode at the beginning until the temperature and acidity are correct.

6. Softer deposits are produced by increasing the acidity, raising the temperature or lowering the current density. Harder deposits are finer grained and contain more oxygen than softer deposits.

7. The temperature must be carefully controlled because variations produce marked changes in the properties of the deposits.

8. Acidity is maintained constant by the addition of HCl every 20 minutes and water that has evaporated is replenished between runs.

A comparison of the aforementioned baths brings out their respective advantages and disadvantages.

The sulphate bath operates at a comparatively low current density but it can be operated at room temperature. The sulphate bath is less corrosive than the chloride bath. Chloride baths permit high current densities thus giving more rapid deposition. They must be used at high temperatures thus causing excessive evaporation of the electrolyte. Chloride baths are very corrosive, must be kept in special acid proof tanks (enamel or rubber lined steel, acid proof brick or wood) and all metal including busbars within a radius of several feet must be protected against its action as there is a marked tendency for spray evolution. The chloride bath requires especially careful regulation.

STAINLESS STEEL POLISHING COMPOUNDS

If It's Stainless Steel Polishing It's a "4-A" Job

It's been proved every day in every kind of metal working plant: "4-A" Polishing Compounds are faster, more efficient and more economical for cutting down, polishing and mirror finishing all kinds of steel, including stainless and radium.

CEMENT AND THINNER

Use it with any kind of wheel —soft, medium or hard—and the results will speak more eloquently than anything we could say.

Tell us about your toughest job, and we'll be glad to send the "4-A" product that will solve your problem No obligation, of course

Instead of glue, use "4-A" Cement and Thinner, a uniform substitute for polishing Wheels, Belts, Buffs, Rolls, etc Samples of Compound or Cement sent on request

HARRISON & COMPANY HAVERHILL, MASS.

FILTERS *Portable or Stationary*

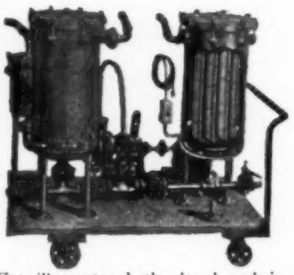
Capacity—200 to 2400 Gallons Per Hour

For:-

- NICKEL & BRIGHT NICKEL
- CHROMIUM
- ACID COPPER
- ZINC & BRITE ZINC
- CYANIDE COPPER & BRASS
- CADMIUM & TIN
- ELECTROCOLOR
- AND OTHER PLATING SOLUTIONS

— Also For —
DEGREASING SOLVENTS, CLEANERS, NEUTRALIZING SOLUTION, ETC.

Many important benefits are derived, and big savings effected in metal cleaning operations, as a result of filtration.



Cut illustrates both closed and internal view of typical filtering unit.

FILTERS for BRIGHT NICKEL are now offered in "Seven" new types and—"Eleven" different sizes.

For specific recommendations, mention kind of solution, number of gallons, etc. Write for our new bulletin and Descriptive literature.

Industrial Filter & Pump Mfg. Co.
3017 West Carroll Avenue Chicago, Ill.

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PERMAG for 100 percent cleaning

Metal fabricators use PERMAG because it is efficient—saves labor—cuts cleaning costs and is always uniform in its quick action.

Used by largest as well as small plants.

PERMAG
Cleaning Compounds
Produced by
MAGNUSON
Products Corporation
Manufacturers of Specialized Scientific Cleaning Compounds for every Industrial purpose
Main Office and Factory, Third & Hoyt Streets
Brooklyn, N. Y. Warehouses in principal cities
In Canada: Canadian Permag Products, Ltd., Montreal, Toronto.

MAGNUSON Research Service

—will help solve the hardest cleaning problems in your industry.

Our service is based on 28 years experience manufacturing, selling, and servicing cleaning compounds.

Let us know of your cleaning problems.

Metal Prices, July 27, 1939

(All quotations are based on wholesale quantities, prompt delivery, New York unless otherwise specified.)

New Metals

Aluminum, Virgin ingot, 99% plus, c.l.	20.00c.
Antimony, Chinese, 99%	14.00c.
Bismuth, Ton lots, American, 99½%	$1.10
Cadmium, Sticks and bars, tons	50c.
Copper, Lake, delivered Conn.	10.25c.
Electrolytic, delivered Conn.	10.25c.
Castings, F.O.B. refinery	9.875c.
Gold, U. S. Treasury price, oz. Troy	$35.00
Lead, Desilvered and Prime Western	4.85c.
Magnesium, 99.95% ingot	30.00c.
Mercury (Quicksilver), Flasks, 75 lb.	$88-$90
Nickel, Ingot or Shot	36.00c.
Electrolytic, 99.95%, sheets	35.00c.
Platinum, oz., Troy	$35.00
Tin, Straits	48.45c.
Zinc, Prime Western	4.60c.
Brass Special	4.70c.
High Grade	5.60c.
Die Casting Alloy	7.50c.

Ingot Metals and Alloys

	Cents per lb.
No. 1 Yellow Brass	8.50
85-5-5-5	10.50
88-10-2	14.25
80-10-10	12.625
Manganese Bronze (60,000 t. s. min.)	10.50
Aluminum Bronze	14.75
Monel Metal Shot or Block	28
Nickel Silver (12% Ni)	12.50
Nickel Silver (15% Ni)	14.75
No. 12 Aluminum	13.00-15.00
Manganese Copper, Grade A (30%)	22-27
Phosphor Copper, 10%	15.00
Phosphor Copper 15%	15.50
Silicon Copper, 10%	21.50
Phosphor Tin, no guarantee	50-60
Iridium Platinum, 5% (Nominal)	$36.50
Iridium Platinum, 10% (Nominal)	$38.00

Old Metals

Dealers' buying prices, wholesale quantities:	Cents per lb.
Heavy copper and wire, mixed	7.125-7.25
Light copper	6.375-6.50
Heavy yellow brass	4.625-4.75
Light brass	3.625-3.75
No. 1 composition	6.375-6.50
No. 1 composition, turnings	6.125-6.25
Heavy soft lead	4.00-4.125
Old zinc	2.25-2.50
New zinc clips	3.00-3.25
Aluminum clips (new, soft)	13.00-14.00
Scrap aluminum, cast	6.50-6.75
Aluminum borings—turnings	4.50-4.75
No. 1 pewter	29.00-30.00
Electrotype	4.25-4.50
Nickel anodes	25.00-26.00
Nickel clips, new	27.00-28.00
Monel scrap	8.00-12.50

Wrought Metals and Alloys

The following are net BASE PRICES per lb., to which must be added extras for size, shape, quantity, packing, etc., or discounts, as shown in manufacturers' lists. Basic quantities on most rolled or drawn brass and bronze items below are from 2,000 to 5,000 lbs.; on nickel silver, from 1,000 to 2,000 lbs.

Copper Material

Sheet, hot rolled	18.50c.
Bare Wire, soft, less than carload	13.75c.
Seamless Tubing	19.00c.

Nickel Silver

Sheet Metal		Wire and Rod	
10% Nickel	25.37c.	10% Nickel	28.00c.
15% Nickel	26.75c.	15% Nickel	31.25c.
18% Nickel	27.75c.	18% Nickel	34.12c.

Aluminum Sheet and Coil

Base Prices Carload Lots (F.O.B. Mill)

Aluminum Sheet, 20 gauge	35.00c.
Aluminum Coils, 20 gauge	28.00c.

Rolled Nickel Sheet and Rod

Base Prices (F.O.B. Mill)

Cold Drawn Rods	50c.	Standard Cold Rolled Sheet	49c.
Hot Rolled Rods	45c.		

Monel Metal Sheet and Rod

Base Prices (F.O.B. Mill)

Hot Rolled Rods	35c.	No. 35 Sheets	37c.
Cold Drawn Rods	40c.	Std. Cold Rolled Sheets	39c.

Silver Sheet

Rolled Sterling Silver, 38c. per Troy oz. upward according to quantity.

Brass and Bronze Material

	Yellow Brass	Red Brass 80%	Comm'l. Bronze
Sheet	16.73c.	17.55c.	18.58c.
Wire	16.98c.	17.80c.	18.83c.
Rod	12.08c.	17.80c.	18.83c.
Angles, channels, open seam tubing	25.23c.	26.05c.	27.08c.
Seamless tubing	19.48c.	20.20c.	20.98c.

Tobin Bronze and Muntz Metal

Tobin Bronze Rod	18.50c.
Muntz Metal Sheet	19.87c.
Muntz Metal Rod	16.00c.

Zinc and Lead Sheet

Zinc Sheet, carload lots standard sizes and gauges, at mill, less 7% discount	9.75c.
Zinc Sheet, 1200 lb. lots (jobbers' prices)	10.75c.
Zinc Sheet, 100 lb. lots (jobbers' prices)	14.75c.
Full Lead Sheet	7.75c.
Cut Lead Sheet	8.00c.

Block Tin, Pewter and Britannia Sheet

This list applies to either block tin or No. 1 Britannia Metal Sheet, No. 23 B. & S. Gauge, 18 inches wide or less; prices are all f.o.b. mill:

500 lbs. over	15c. above N. Y. pig tin price
100 to 500 lbs.	17c. above N. Y. pig tin price
Up to 100 lbs.	25c. above N. Y. pig tin price

Supply prices on page 398.

Supply Prices, July 27, 1939

Anodes

Prices, except silver, are per lb. f.o.b., shipping point, based on purchases of 2,000 lbs. or more, and subject to changes due to fluctuating metal markets.

COPPER: Cast 19⅞c. per lb.
Electrolytic, full size, 14⅞c.; cut to size 14⅞c. per lb.
Rolled oval, straight, 15⅜c.; curved .. 16⅜c. per lb.
BRASS: Cast 16¾c. per lb.
ZINC: Cast 10 c. per lb.
NICKEL: 90-92%, 16" and over .45 per lb.
95-97%, 16" " " .46 per lb.
99%+cast, 16" and over, 47c.; rolled, depolarized, 16" and over, 48c.
SILVER: Rolled silver anodes .999 fine were quoted from 46c. per Troy ounce upward, depending on quantity.

Chemicals

These are manufacturers' quantity prices and based on delivery from New York City.

Acetone, C.P. l.c.l., drums	lb.	.06¼
Acid, Boric (boracic) granular, 99.5%, bbls.	lb.	.053-.059
Chromic, 99%, 100 lb. and 400 lb. drums	lb.	.16¾-.17¼
Hydrochloric (muriatic) Tech., 20°, carboys	lb.	.027
Hydrochloric, C.P., 20°, carboys	lb.	.08
Hydrofluoric, 30%, bbls.	lb.	.07-.08
Nitric, 36°, carboys	lb.	.06
Nitric, 42°, carboys	lb.	.075
Oleic (Red Oil), distilled, drums	lb.	.08⅜
Oxalic, bbls. l.c.l.	lb.	.12-.14
Stearic, double pressed, distilled, bags	lb.	.10½-.11½
single pressed, bags	lb.	.10-.11
triple pressed bags	lb.	.13½-.14½
Sulphuric, 66°, carboys	lb.	.025
Alcohol, Amyl, l.c.l., drums	lb.	.15-.165
Butyl-normal, l.c.l., drums	lb.	.085
Denatured, S.D. No. 1, 190 pf., bbls., works	gal.	.305-.315
Diacetone, pure, drums, l.c.l.	lb.	.095
Methyl, (Methanol), 95%, drums, l.c.l.	gal.	.385
Propyl-Iso, 99%, l.c.l., drums	gal.	.41
Propyl-Normal, drums	gal.	.70
Alum, ammonia, granular, bbls., works	lb.	.0315
Potash, granular, bbls., works	lb.	.034-.037
Ammonia, aqua, 26°, drums, carboys	lb.	.02¼-.05¼
Ammonium, chloride (sal-ammoniac), white, granular, bbls.	lb.	.05-.075
Sulphate, tech., bbls.	lb.	.035-.05
Sulphocyanide (thiocyanate), pure, crystal, kegs	lb.	.55-.58
Sulphocyanide (thiocyanate), com'l, drums	lb.	.16
Antimony Chloride (butter of antimony), sol., carboys	lb.	.13-.153
Barium Carbonate, ppted., l.c.l., bags, works	lb.	.03
Benzene (Benzol), pure, drums	gal.	.21
Butyl Lactate, drums	lb.	.225
Cadmium Oxide, l.c.l., bbls	lb.	.55
Calcium Carbonate (Ppted. chalk), U.S.P.	lb.	.05¾-.075
Carbon Bisulfide, l.c.l., 55 gal. drums	lb.	.05¾-.06
Carbon Tetrachloride, l.c.l., drums	gal.	.73
Chrome, green, commercial, bbls.	lb.	.22
Chromic Sulphate, drums	lb.	.26¼
Cobalt Sulphate, drums	lb.	.59
*Copper, Acetate (verdigris), bbls.	lb.	.25
Carbonate, 53/55%, bbls.	lb.	.14½-.15½
Cyanide, Tech., 100 lb. bbls.	lb.	.34
Sulphate, Tech., crystals, bbls.	lb.	.05
Cream of Tartar (potassium bitartrate), crystals, kegs	lb.	.23¼
Crocus Martis (iron oxide) red, tech., kegs	lb.	.07
Dibutyl Phthalate, l.c.l., drums	lb.	.195
Diethylene Glycol, l.c.l., drums, works	lb.	.155
Dextrine, yellow, kegs	lb.	.05-.08
Emery Flour (Turkish)	lb.	.07
Ethyl Acetate, 85%, l.c.l., drums	lb.	.066
Ethylene Glycol, l.c.l., drums, works	lb.	.17-.20
Flint, powdered	ton	30.00
Fluorspar No. 1 ground, 97-98%.	ton	$60.00
Fusel Oil, refined, drums	lb.	.125-.14
*Gold, Chloride	oz.	$18¼-23
Cyanide, potassium 41%	oz.	$15.45
Cyanide, sodium 46%	oz.	$17.10

*Subject to fluctuations in metal prices.

Gum, Arabic, white, powder, bbls.	lb.	.125-.14
Sandarac, prime, bags	lb.	.50
Hydrogen Peroxide, 100 volume, carboys	lb.	.20
Iron Sulphate (Copperas), bbls.	lb.	.016
Lead, Acetate (Sugar of Lead), bbls.	lb.	.10-.12¾
Oxide (Litharge), bbls.	lb.	.125
Magnesium Sulphate (Epsom Salts), tech., bag	lb.	.018
Mercury Bichloride (Corrosive Sublimate)	lb.	$1.58
Mercuric Oxide, red, powder, drums	lb.	$1.81
Nickel, Carbonate, dry, bbls.	lb.	.36-.41
Chloride, bbls.	lb.	.18-.22
Salts, single, 425 lb. bbls.	lb.	.135-.145
Salts, double, 425 lb. bbls.	lb.	.135-.145
Paraffin	lb.	.05-.06
Phosphorus, red	lb.	.42
yellow	lb.	.55
Potash, Caustic, 88-92%, flake, drums, works	lb.	.07¼-.075
Potassium, Bichromate, crystals, casks	lb.	.09¼
Carbonate (potash) 98-100%, drums	lb.	.06¾
Cyanide, 94-96%, cases	lb.	.525
Pumice, ground, bbls.	lb.	.03
Quartz, powdered	ton	$30.00
Quicksilver (Mercury) 76 lb. flasks	flask	$89.-$92
Rochelle Salts, crystals, bbls.	lb.	18.25
Rosin, gum, bbls.	lb.	5.25-7.75
*Silver, Chloride, dry, 100 oz. lots	oz.	.31
Cyanide, 100 oz. lots	oz.	.36½
Nitrate, 100 oz. lots	oz.	.27
Sodium, Carbonate (soda ash), 58%, bbls.	lb.	.0235
Cyanide 96%, 100 lb. drums	lb.	.15
Hydroxide (caustic soda) 76%, flake	lb.	.0355
Hyposulphite, crystals, bbls.	lb.	.035-.065
Metasilicate, granular, bbls.	lb.	.0315
Nitrate, tech., bbls.	lb.	.029
Phosphate, tribasic, tech., bbls.	lb.	.027
Pyrophosphate, anhydrous, bbls., l.c.l.	lb.	.056
Sesquisilicate, drums	lb.	.0405
*Stannate, drums	lb.	.32½-.34½
Sulphate (Glauber's Salts), crystals, bbls., works	lb.	.0135
Sulphocyanide, drums	lb.	.30-.35
Sulphur, Flowers, bbls., works	lb.	.037-.0410
*Tin Chloride, 100 lb. kegs	lb.	.37½
Toluene (Toluol), pure, drums, works	gal.	.27
Tripoli, powdered	lb.	.03
Wax, Bees, white, bleached, slabs 500 lbs.	lb.	.36-.40
Bees, yellow, crude	lb.	.21-.215
Carnauba, refined, bags	lb.	.34-.35
Montan, bags	lb.	.115-.12
Spermaceti, blocks	lb.	.23
Whiting, Bolted	lb.	.025-.06
Xylene (Xylol), drums, works	gal.	.31
Zinc, carbonate, bbls.	lb.	.14-.15
Cyanide, 100 lb. kegs	lb.	.33
Chloride, granular, drums	lb.	.06
Sulphate, crystals, bbls.	lb.	.04

Metal prices on page 397.